United States Air Force
611th Civil Engineer Squadron

Elmendorf AFB, Alaska

Final
Baseline Risk Assessment Report
Galena Airport
Alaska

Volume 3 - Appendices C - K

March 1996

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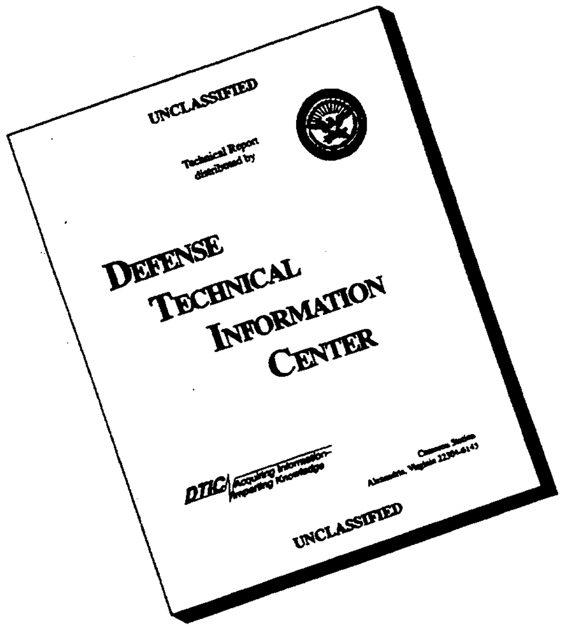

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United States Air Force
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Final

Baseline Risk Assessment for the Fire Protection Training Area, POL Area, and the West Unit Source Areas of Galena Airport, Alaska

Volume 3—Appendices C - K

March 1996

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APPENDIX C

Groundwater Modeling

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C.1 PURPOSE FOR MODELING

This modeling was conducted to predict concentrations of COPCs at the shoreline of the Yukon River. For the purpose of this task, all of the COPCs from the following source areas were modeled:

- Fire Protection Training Area;
- POL Tank Farm; and
- West Unit, which includes:
  - Building 1845;
  - Power Plant UST No. 49;
  - Waste Accumulation Area;
  - JP-4 Fillstands Area; and
  - Million Gallon Hill.

Once calibrated, the model parameters were set to predict the concentrations of the chemicals at a location on the shoreline of the Yukon River directly downgradient of groundwater flow from each of the various source areas.

Groundwater modeling from two additional source areas, the Southeast Runway Fuel Spill Area and the Control Tower Drum Storage Area, South, was conducted using the methodology described in this appendix. The results of the modeling for these two source areas, however, are presented in the Volume 4 Addendum.

C.2 MODELING METHODS

The model chosen for this process solves the two-dimensional advection dispersion equation for a homogeneous, isotropic porous medium having a unidirectional steady state flow

based on the input values of the variables listed in Table C-1. It simulates a solute being released from a strip source, orthogonal to the flow field. The advected solute undergoes first-order decay and sorption-desorption expressed as a retardation factor. The model returns the relative solute concentration, (c) at {x,y,t}. The equations and partial programming code for the model were extracted from the following listed sources. The modeling code was written by Radian in the Fortran 77 and S-Plus programming languages. Reference: Javandel, Doughty, and Tsang (1984). Groundwater Transport: Handbook of Mathematical Models. Implementation of Equation (48), Page 19.

The modeling technique was broken up into three steps. In the first step, the model was calibrated to match measured field conditions. Reasonable ranges of parameters (defined in Table C-1) were input into the model in varying configurations in order to calibrate the model. The results were then compared to measured field concentrations to screen out the configurations that did not match. The second step was to use the parameter configurations that matched measured field data to estimate the concentrations of contaminants at the areas of concern. This was accomplished by changing the "x", "y", and "t" parameters to estimate steady state concentrations in the particular area of concern relative to the source area. At least one, but usually two or more, target constituent(s) were taken through the first two steps. The shoreline concentration estimates for remaining COPCs were determined in the final step. In the last step, the configuration of parameters which were calibrated to fit the modeled constituents field data was input into the model with the respective lowest reported decay coefficients for each remaining constituent. The resulting relative solute concentration (c) was then multiplied by the highest measured concentration at the source to predict the concentration at {x,y,t}.

C.3 MODELING ASSUMPTIONS

All maximum detections were simulated in the modeling. After calibration with the target compounds, the maximum concentration for all of the constituents detected was input into the model as a continuously releasing source to model each constituent's concentration at the shoreline.

Table C-1
Galena Groundwater Parameters

Variable Name	Units	Values(s) Used	Source/Comments
Position in direction of ground water flow (x)	ft	-	Determined by the spatial relationships between the monitoring wells, and between the source area and the area of concern.
Position normal to groundwater flow (y)	ft	-	Determined by the spatial relationships between the monitoring wells, and between the source area and the area of concern.
Lower limit of integration (t_o)	days	-	Determined by "x" and the dispersion rate (dl). Values used estimated the time immediately before the head of the plume reached the area of concern.
Time since start of solute release (t)	days	-	Determined by "x" and the dispersion rate (dl). Values used estimated the time directly after the contaminant concentration reached steady state at the area of concern.
Strip source half width (a)	ft	-	Determined by the spatial relationships between the monitoring wells of the modeled source area and the concentrations measured at those wells.
Ground water flow velocity (v)	ft/day	0.5, 1, and 1.3	These values were used to test the possible range of flow rates reported in the Draft Final Remedial Investigation Report Galena Airport and Champion Air Force Station Volume I.
Retardation factor (r)	-	1	Retardation is factored out of the model.
First-order decay coefficient of solute (alam)	1/days	-	These values are chemical specific. The range of values used were taken from "The Handbook of Environmental Degradation Rates" by Howard, et al. 1991.
Longitudinal dispersion coefficient (dl)	ft^2/days	0.5, 1, 5, 10, and 15	Range of values selected based on M.P. Anderson's 1979 paper "Using Models to Simulate the Movement of Contaminants Through Groundwater Flow Systems."
Transverse dispersion coefficient (dt)	ft^2/days	dl/10	Range of values selected based on M.P. Anderson's 1979 paper "Using Models to Simulate the Movement of Contaminants Through Groundwater Flow Systems."

The decay rates used were taken from "The Handbook of Environmental Degradation Rates" by Howard, et al. 1991. The book lists groundwater lower and upper half lives for most of the constituents at Galena based on historical reported data. Since our model takes decay rate rather than half life, we converted the half lives to decay rates. After calibrating the model for each site (mostly by finding groundwater velocity and dispersion rates that fit measured data), the most conservative rate that the book listed was used in the model to estimate the final concentrations. For constituents that were not listed in the book, we used a decay rate of 0. For most constituents, the decay rates used were the most conservative listed in Howard et al., which is a wide ranging compilation of other scientists' studies and data.

For all metals the decay rate was set to 0. For pesticides, the most conservative half-life found for each pesticide was used. For instance, a half-life of over three years was used for DDD, DDT, and DDE.

The model was calibrated for each site using one or more key constituents taken from actual field data. For those key constituents, the modeling results had to match field data in order for the model to be considered calibrated. Numbers of simulations ranging from 200 to over 750 were used to calibrate the model for each site. Each simulation was made with a different configuration of the models parameters. Typically, from each set of simulations less that 10 configurations of parameters fit measured field values. The most conservative decay rates reported in Howard et al. were used for all other constituents at each site; therefore, the predicted levels may not match field data precisely, but they should be conservative if they do not. If the wells at a site were not configured in an upgradient to downgradient fashion, even more conservative numbers had to be used, because the well configuration did not allow the model to be calibrated as accurately. This, again is a conservative approach that lead to some inconsistencies between sites. For the sites that had multiple wells, the range of possible parameters could be narrowed down to more accurately simulate actual field conditions. Instead of using these parameters for other sites, only the parameters that were obtainable from the existing well configurations at a particular site were used.

The difference in degradation between contaminants in modeled shoreline concentrations is due to the conservatism built into the modeling technique. Several key constituents were selected at each site to calibrate the model to the field data, and the remaining constituents were modeled with all of the calibrated parameters except decay rates (where the individual constituents rates were used). At least several hundred simulations were performed at each site for each key constituent to calibrate the model. The model was considered calibrated for a specific site when a set of aquifer parameters (dispersion and velocity) yielded results consistent with field data, typically for at least two or three constituents. As an example of how differences in modeled degradation rates could occur, benzene was used as one of the key constituents at almost every site because it was analyzed for, and detected, at most of the wells. Of the hundreds of simulations using benzene, the model could not calibrate using the most conservative decay rates for benzene. Therefore the decay rate was increased until the model would calibrate. The final half-life for benzene used in the modeling was 70 days. A disparity between the degradation of BTEX components occurred because the toluene, ethylbenzene, and xylene decay rates were not raised above the most conservative levels reported by the Howard et al. To be consistent, we could have correspondingly lowered the half lives (raised the decay rates) of the other constituents at the site, but it was much more conservative and defensible to use the maximum half-lives reported in the source book.

In the context of this report, steady state means that a source is continuously releasing the contaminant at a steady rate, and after a certain number of days (years) depending on the groundwater parameters, the plume footprint will stabilize. Steady state was assumed in the modeling as this is a more conservative approach than assuming an isolated release that is no longer occurring.

Uncertainties in flow velocities were accounted for in the calibration step. Neglecting the effects of dispersion, the extrapolation of concentration in time is independent of the flow velocity, provided that the observed concentration at known points is honored. The key assumption is homogeneity. Preferential flow pathways may well exist, and would indeed have a significant impact on predicted concentrations. However, inclusion of possible, yet

uncharacterized inhomogeneities is beyond the scope of this analysis. Similarly, model calibration should also account for variations in cold-climate decay rates as well as volatilization.

A wide range of dispersion values was tested in the modeling, and the ones used are on the low end of the M.P. Anderson (1979) values. Along with velocity, dispersion values were used to calibrate the model with field data. Typically over 200 simulations were run at each site. The final dispersion levels used were chosen because they were the values in the simulations that allowed the model to produce results consistent with field measurements.

C.4 RIVER DILUTION METHODOLOGY AND ASSUMPTIONS

The final river concentrations were calculated for a five foot mixing zone from the shoreline. The mixing zone is assumed to be five feet from the river's edge to provide conservative estimates of concentrations as well as simulate actual river flow characteristics. The concentration of each contaminant was calculated within this mixing zone according to the five step process outlined below.

Step 1—Calculate constituent inflow into the river:

Constituent inflow (μg/day) = GW flow (ft/day) * porosity (unitless) * conversion factor (l/ft^3) * plume cross-section of river (ft^2) * shoreline concentration of constituent (μg/l)

Where:

GW flow = 1 ft/day everywhere except the FPTA where it is 1.3 ft/day

porosity = 0.35

conversion factor = 28.316 l/ft^3

plume cross-section of river = 30 ft (depth) * plume width at river (ft) (values of the plume width range from 1500 ft at the POL Area to 310 ft at Bldg 1845).

Step 2—Calculate river flow within a 5-foot mixing zone of the shoreline

5-foot zone river flow (ft^3/sec) = total river flow (ft^3/sec) * mixing zone X-sectional area (ft^2) / river X-sectional area (ft^2) * friction flow reduction factor (unitless)

Where:

total river flow	=	225,000 ft^3/sec
mixing zone X-sectional area	=	5 ft * 1584 ft
river X-sectional area	=	23 ft * 3168 ft
friction flow reduction factor	=	0.1 (X-sectional flow at edge is approx. 1/10 average flow)

Step 3—Convert river flow to l/day

5-foot zone river flow (l/day) = mixing zone river flow (ft^3/sec) * conversion factor (l/ft^3) * conversion factor (sec/day)

Where:

conversion factor (sec/day) = 86,400 sec/day

Step 4—Calculate final 5-foot mixing zone concentrations

Final 5-foot mixing zone concentration (µg/l) = [constituent inflow (µg/day)] / [5-foot flow (l/day)]

Step 5—Add upstream values of constituents with downstream values to account for downstream accumulations.

All modeled values for shoreline concentrations and 5-foot mixing zone river concentrations are listed in Table C-2.

C.5 REFERENCES

Anderson, M.P. "Using Models to Simulate the Movement of Contaminants through Groundwater Flow Systems", In *CRC Crit. Rev. Environ. Control, 9(2), 97-156.* 1979.

Howard, P.H. et al. *The Handbook of Environmental Degradation Rates.* Lewis Publishers. 1991.

Javendel, I., C. Doughty, and C.F. Tsang. *Groundwater Transport: Handbook of Mathematical Models.* American Geophysical Union. 1984.

Table C-2
Modeling Results

Analyte	Location	Year	Result (ppb)	Shoreline Conc. (ppb)	River Conc. within 5ft mixing zone (ppb)
POL Tank Farm					
1,1-Dichloroethene	G94-05-MW-04	1994	1.75e+01	2.77e-05	2.06e-09
1,2-Dichloroethane	05-MW-07	1994	5.92e+01	7.63e-02	1.10e-05
2,4-Dimethylphenol	G94-05-MW-04	1994	1.50e+02	6.28e-43	4.68e-47
2-Butanone (MEK)	G94-05-MW-04	1994	4.00e+02	1.67e-42	1.25e-46
2-Methylnaphthalene	05-MW-10-01	1992	1.20e+03	7.64e+01	5.70e-03
2-Methylphenol(o-cresol)	G94-05-MW-07	1994	4.15e+02	1.74e-42	1.30e-46
4,4'-DDD	05-MW-10-01	1992	2.20e-01	1.24e-02	9.22e-07
4,4'-DDE	05-MW-10-01	1992	2.70e-01	1.52e-02	1.13e-06
4,4'-DDT	G94-05-MW-07	1994	5.06e-02	2.85e-03	3.17e-07
4-Methyl-2-Pentanone(MIBK)	G94-05-MW-05	1994	4.62e+01	1.93e-43	1.44e-47
4-Methylphenol(p-cresol)	05-MW-04-03	1993	5.80e+01	7.44e-22	5.54e-26
4-Methylphenol/3-Methylphenol	G94-05-MW-04	1994	2.52e+02	1.61e+01	1.20e-03
Acetone	05-MW-10	1994	2.40e+04	1.00e-40	7.49e-45
Acenaphthalene			3.50e+02	1.89e-02	1.41e-06
Aldrin	G94-05-MW-04	1994	4.07e-02	7.93e-04	5.91e-08
alpha-BHC	G94-05-MW-07	1994	1.61e-01	5.70e-05	2.45e-08
Benzene	05-MW-05	1994	4.10e+04	4.48e-06	4.12e-06
Benzoic acid	G94-05-MW-04	1994	1.07e+04	6.81e+02	5.08e-02
Benzyl alcohol	G94-05-MW-03	1994	4.65e+00	2.96e-01	2.21e-05
beta-BHC	G94-05-MW-11	1994	2.30e-03	5.22e-07	3.12e-08
bis(2-Ethylhexyl)phthalate	05-MW-05	1994	1.41e+01	2.46e-02	1.83e-06
Bromochloromethane	05-MW-04-03	1993	2.08e+01	1.32e+00	3.70e-04
Chlorobenzene	G94-05-MW-04	1994	1.75e+01	1.05e-02	7.80e-07
Chloroethane	G94-05-MW-05	1994	1.20e+00	1.04e-12	7.75e-17
Chloromethane	05-MW-04	1994	2.22e+02	1.92e-10	2.30e-09
Dibenzofuran	G94-05-MW-07	1994	5.93e+00	1.43e-18	1.07e-22
Dibromomethane	G94-05-MW-06	1994	2.20e-01	1.91e-13	8.30e-10
Dieldrin	G94-05-MW-06	1994	1.69e-02	5.63e-04	6.74e-08
Endosulfan I	G94-05-MW-11	1994	3.60e-03	8.93e-71	6.66e-75
Endosulfan sulfate	G94-05-MW-04	1994	2.74e-02	1.75e-03	1.30e-07
Endrin	G94-05-MW-05	1994	9.00e-04	5.73e-05	4.27e-09
Endrin aldehyde	G94-05-MW-06	1994	1.40e-03	8.92e-05	6.65e-09
Ethylbenzene	05-MW-10	1994	1.20e+03	1.64e-01	1.24e-05

Table C-2
(Continued)

Analyte	Location	Year	Result (ppb)	Shoreline Conc. (ppb)	River Conc. within 5ft mixing zone (ppb)
Fluorene	G94-05-MW-07	1994	5.89e+00	3.20e-06	2.38e-10
gamma-BHC	G94-05-MW-07	1994	1.56e-01	2.89e-05	3.05e-08
Heptachlor	G94-05-MW-05	1994	1.25e-02	8.79e-116	2.03e-45
Heptachlor epoxide	G94-05-MW-04	1994	1.24e-01	2.22e-03	1.95e-07
Iron	05-MW-05-03	1993	8.47e+04	5.39e+03	4.02e-01
Lead	05-MW-05-03	1993	1.64e+01	1.04e+00	1.44e-04
Methylene chloride	05-MW-04	1994	3.98e+02	3.45e-10	2.57e-14
Naphthalene	G94-05-MW-05	1994	1.43e+02	3.97e-02	2.96e-06
Phenanthrene	G94-05-MW-07	1994	7.87e-01	1.52e-03	1.13e-07
Phenol	G94-05-MW-07	1994	3.02e+02	1.74e-85	1.30e-89
Thallium	05-MW-06-03	1993	7.98e+01	5.08e+00	3.79e-04
Toluene	05-MW-10	1994	2.10e+04	2.69e-19	3.51e-13
Trichloroethene	G94-05-MW-05	1994	4.50e+00	1.23e-01	9.16e-06
Trichlorofluoromethane	G94-05-MW-02	1994	1.90e-01	1.73e-03	1.29e-07
Xylene (total)	05-MW-05-01	1992	2.70e+05	3.48e+02	2.59e-02
Fire Protection Training Area					
1,2-Dichloroethane	G94-01-MW-01	1994	1.40e+00	1.03e-01	5.35e-06
4,4'-DDT	G94-01-MW-01	1994	8.00e-03	2.04e-03	1.05e-07
alpha-BHC	G94-01-MW-06	1994	8.10e-03	3.92e-04	2.03e-08
Benzene	01-MW-06	1994	2.24e+02	7.98e-02	4.12e-06
beta-BHC	G94-01-MW-01	1994	1.44e-02	6.02e-04	3.11e-08
Bromochloromethane	01-MW-08-01	1993	1.98e+01	5.25e+00	2.71e-04
Chloromethane	G94-01-MW-02	1994	6.10e-01	4.45e-05	2.30e-09
Dibromomethane	G94-01-MW-01	1994	2.20e-01	1.61e-05	8.30e-10
Dieldrin	G94-01-MW-08	1994	2.30e-03	4.93e-04	2.55e-08
Ethylbenzene	G94-01-MW-01	1994	1.00e-01	3.55e-03	1.83e-07
gamma-BHC	01-MW-05-01	1992	1.40e-02	5.48e-04	2.83e-08
Heptachlor	G94-01-MW-07	1994	6.00e-04	3.93e-41	2.03e-45
Heptachlor epoxide	G94-01-MW-06	1994	3.30e-03	5.78e-04	2.98e-08
Lead	01-MW-08-01	1993	4.80e+00	1.27e+00	6.58e-05
Methoxychlor	G94-01-MW-05	1994	5.25e-02	3.96e-03	2.05e-07
Toluene	G94-01-MW-06	1994	3.30e-01	6.80e-09	3.51e-13
Xylene (total)	01-MW-01-03	1993	1.10e+00	8.13e-02	4.20e-06

Table C-2
(Continued)

Analyte	Location	Year	Result (ppb)	Shoreline Conc. (ppb)	River Conc. within 5ft mixing zone (ppb)
West Unit (Building 1845)					
1,1,2-Trichloroethane	G94-06-MW-01	1994	1.26e+00	3.16e-02	4.87e-07
1,1-Dichloroethane	G94-06-MW-01	1994	7.10e-01	3.32e-03	5.12e-08
1,1-Dichloroethene	G94-06-MW-01	1994	5.65e+00	8.95e-05	1.38e-09
1,2-Dichloroethane	G94-06-MW-07	1994	1.18e+00	5.52e-03	8.51e-08
4,4'-DDD	G94-06-MW-02	1994	9.10e-02	1.05e-02	1.61e-07
4,4'-DDE	G94-06-MW-02	1994	7.60e-03	8.75e-04	1.35e-08
4,4'-DDT	G94-06-MW-06	1994	1.70e-02	1.96e-03	3.02e-08
4-Methyl-2-Pentanone(MIBK)	G94-06-MW-06	1994	5.57e+00	1.34e-37	2.06e-42
Aldrin	G94-06-MW-06	1994	6.13e-02	2.87e-03	4.43e-08
alpha-BHC	G94-06-MW-06	1994	4.41e-02	6.89e-05	1.06e-09
Arsenic	06-MW-07-01	1993	1.32e+01	1.69e+00	2.60e-05
Benzene	G94-06-MW-01	1994	6.40e-01	2.98e-09	4.58e-14
beta-BHC	G94-06-MW-06	1994	2.84e-01	3.05e-04	4.69e-09
bis(2-Ethylhexyl)phthalate	G94-06-MW-02	1994	2.24e+00	1.36e-02	2.09e-07
Bromochloromethane	06-MW-01-03	1993	2.13e+03	2.73e+02	4.20e-03
Cadmium	06-MW-07-01	1993	8.40e+00	1.08e+00	1.66e-05
Chloroform	G94-06-MW-01	1994	1.96e+00	1.30e-01	2.00e-06
Chloromethane	G94-06-MW-07	1994	5.30e-01	4.05e-11	6.24e-16
cis-1,2-Dichloroethene	G94-06-MW-01	1994	2.60e+03	3.33e+02	5.13e-03
Dieldrin	G94-06-MW-06	1994	3.44e-02	2.54e-03	3.91e-08
Endosulfan sulfate	G94-06-MW-02	1994	1.40e-03	1.79e-04	2.76e-09
Endrin aldehyde	G94-06-MW-06	1994	4.58e-02	5.86e-03	9.03e-08
Ethylbenzene	G94-06-MW-06	1994	6.00e-02	4.19e-05	6.46e-10
gamma-BHC	G94-06-MW-06	1994	1.11e-01	1.00e-04	1.54e-09
Heptachlor	G94-06-MW-06	1994	4.67e-02	2.62e-98	4.04e-103
Heptachlor epoxide	G94-06-MW-06	1994	2.57e-02	1.12e-03	1.73e-08
Lead	06-MW-01-03	1993	9.50e+00	1.22e+00	1.87e-05
Phenanthrene	06-MW-06-01	1992	6.90e-01	4.55e-03	7.01e-08
Sodium	06-MW-01-03	1993	3.68e+04	4.71e+03	7.25e-02
Tetrachloroethene	G94-06-MW-06	1994	3.30e-01	8.10e-03	1.25e-07
trans-1,2-Dichloroethene	G94-06-MW-01	1994	1.85e+02	2.37e+01	3.65e-04
Trichloroethene	G94-06-MW-01	1994	7.55e+03	4.71e+02	7.26e-03
Trichlorofluoromethane	G94-06-MW-01	1994	1.10e-01	2.70e-03	4.16e-08

Table C-2
(Continued)

Analyte	Location	Year	Result (ppb)	Shoreline Conc. (ppb)	River Conc. within 5ft mixing zone (ppb)
Vinyl Chloride	G94-06-MW-01	1994	7.60e-01	6.43e-02	9.91e-07
West Unit (JP-4 Fillstands)					
1,1-Dichloroethane	G94-10-MW-03	1994	2.80e-01	1.31e-03	2.44e-08
1,2-Dichloroethane	G94-10-MW-01	1994	4.30e-01	2.01e-03	3.75e-08
2-Methylnaphthalene	10-MW-02-03	1993	6.81e+00	8.72e-01	1.62e-05
2-Methylphenol(o-cresol)	10-MW-02-02	1992	3.30e+00	7.92e-38	1.48e-42
4,4'-DDD	10-MW-01-02	1992	2.70e-02	3.11e-03	5.79e-08
4,4'-DDT	G94-10-MW-03	1994	9.70e-03	1.12e-03	2.08e-08
4-Methylphenol(p-cresol)	10-MW-02-02	1992	1.30e+01	6.17e-19	1.15e-23
Aldrin	10-MW-02-02	1992	1.60e-02	7.50e-04	1.40e-08
alpha-BHC	10-MW-03-02	1992	2.20e-02	3.44e-05	6.41e-10
Arsenic	10-MW-02-03	1993	4.22e+01	5.40e+00	1.01e-04
Barium	10-MW-02-03	1993	8.75e+02	1.12e+02	2.09e-03
Benzene	10-MW-03	1994	8.29e+01	3.85e-07	7.18e-12
Benzoic acid	10-MW-02-03	1993	3.27e+00	4.18e-01	7.80e-06
beta-BHC	10-MW-03-02	1992	4.30e-02	4.61e-05	8.59e-10
bis(2-Ethylhexyl)phthalate	G94-10-MW-03	1994	1.80e+00	1.09e-02	2.03e-07
Bromochloromethane	10-MW-04-01	1993	1.96e+01	2.51e+00	4.67e-05
cis-1,2-Dichloroethene	G94-10-MW-01	1994	1.22e+00	1.56e-01	2.91e-06
Endosulfan I	10-MW-02-02	1992	2.70e-03	1.03e-60	1.92e-65
Endrin aldehyde	10-MW-02-02	1992	1.00e-02	1.28e-03	2.38e-08
Ethylbenzene	G94-10-MW-03	1994	5.00e-01	3.49e-04	6.51e-09
gamma-BHC	10-MW-02-03	1993	1.91e-02	1.73e-05	3.22e-10
Heptachlor	10-MW-02-02	1992	4.30e-03	2.42e-99	4.50e-104
Heptachlor epoxide	10-MW-02-03	1993	5.10e-03	2.22e-04	4.14e-09
Iron	10-MW-02-02	1992	1.50e+05	1.92e+04	3.58e-01
Lead	10-MW-02-02	1992	8.90e+00	1.14e+00	2.12e-05
Naphthalene	10-MW-02-03	1993	1.45e+01	1.85e-02	3.44e-07
Phenol	10-MW-02-03	1993	5.66e+00	3.94e-74	7.34e-79
Selenium	10-MW-03-03	1993	6.46e+00	8.27e-01	1.54e-05
Sodium	10-MW-01-03	1993	3.12e+04	3.99e+03	7.44e-02
Toluene	G94-10-MW-01	1994	5.00e-02	2.37e-21	4.42e-26
Trichloroethene	G94-10-MW-01	1994	1.51e+00	9.42e-02	1.76e-06
Xylene (total)	10-MW-02-03	1993	4.03e+02	1.89e+00	3.52e-05

Table C-2
(Continued)

Analyte	Location	Year	Result (ppb)	Shoreline Conc. (ppb)	River Conc. within 5ft mixing zone (ppb)
West Unit (Million Gallon Hill)					
1,1-Dichloroethane	G94-09-MW-02	1994	2.10e-01	9.83e-04	8.17e-08
1,1-Dichloroethene	G94-09-MW-01	1994	7.00e-02	1.11e-06	3.48e-09
1,2-Dichloroethane	G94-06-MW-04	1994	7.00e-01	3.28e-03	1.13e-05
2-Butanone (MEK)	G94-09-MW-08	1994	3.36e+02	8.06e-36	2.50e-40
2-Methylnaphthalene	G94-09-MW-12	1994	4.74e+03	6.07e+02	2.46e-02
2-Methylphenol(o-cresol)	G94-06-MW-04	1994	1.79e+00	4.29e-38	2.55e-42
4,4'-DDD	G94-09-MW-12	1994	5.52e-01	6.36e-02	3.06e-06
4,4'-DDE	G94-09-MW-12	1994	7.91e-02	9.11e-03	1.43e-06
4,4'-DDT	G94-09-MW-06	1994	2.60e-02	2.99e-03	4.86e-07
4-Methylphenol/3-Methylphenol	G94-06-MW-04	1994	3.62e+00	4.63e-01	1.21e-03
Acenaphthene	G94-09-MW-12	1994	3.96e+01	1.49e-02	4.64e-07
Acetone	G94-09-MW-08	1994	7.56e+02	1.81e-35	5.63e-40
Aldrin	G94-09-MW-12	1994	8.10e-03	3.80e-04	1.15e-07
alpha-BHC	G94-09-MW-08	1994	1.05e-01	1.64e-04	3.12e-08
Barium	09-MW-06-03	1993	9.29e+01	1.19e+01	3.14e-03
Benzene	09-MW-12	1994	3.38e+03	1.57e-05	9.78e-06
beta-BHC	09-MW-12-01	1992	1.50e-01	1.61e-04	4.17e-08
bis(2-Ethylhexyl)phthalate	G94-09-MW-05	1994	4.18e+00	2.53e-02	3.00e-06
Bromochloromethane	09-MW-01-03	1993	1.97e+01	2.52e+00	4.69e-03
Chloroethane	G94-06-MW-04	1994	2.50e-01	1.91e-11	6.71e-16
Chloromethane	09-MW-08	1994	4.80e+01	3.67e-09	2.30e-09
cis-1,2-Dichloroethene	G94-09-MW-01	1994	2.80e+01	3.58e+00	5.24e-03
Dibenzofuran	G94-09-MW-12	1994	2.77e+01	5.69e-15	1.77e-19
Dibromomethane	G94-09-MW-08	1994	6.00e+01	4.59e-09	8.30e-10
Dieldrin	G94-09-MW-06	1994	1.37e-02	1.01e-03	1.50e-07
Endosulfan sulfate	G94-09-MW-15	1994	7.90e-03	1.01e-03	1.65e-07
Endrin aldehyde	G94-09-MW-02	1994	2.20e-03	2.82e-04	1.08e-07
Ethylbenzene	G94-09-MW-12	1994	3.61e+02	2.52e-01	2.03e-05
Fluorene	G94-09-MW-12	1994	9.19e+01	5.87e-04	1.85e-08
gamma-BHC	G94-06-MW-04	1994	5.11e-02	4.62e-05	3.43e-08
Heptachlor	G94-09-MW-06	1994	5.00e-04	2.81e-100	2.03e-45
Heptachlor epoxide	G94-09-MW-06	1994	1.61e-02	7.02e-04	2.34e-07
Iron	09-MW-08-01	1992	1.30e+05	1.66e+04	1.22e+00
Lead	09-MW-10-01	1992	2.00e+01	2.56e+00	2.85e-04
Methylene chloride	09-MW-08	1994	6.00e+01	4.59e-09	1.68e-13
Naphthalene	09-MW-12	1994	2.57e+03	3.27e+00	1.05e-04

Table C-2
(Continued)

Analyte	Location	Year	Result (ppb)	Shoreline Conc. (ppb)	River Conc. within 5ft mixing zone (ppb)
Phenanthrene	G94-09-MW-12	1994	3.84e+01	2.53e-01	8.05e-06
Phenol	G94-09-MW-12	1994	1.36e+02	9.46e-73	3.00e-77
Toluene	09-MW-12	1994	1.29e+03	6.12e-17	3.51e-13
trans-1,2-Dichloroethene	G94-09-MW-01	1994	3.32e+00	4.25e-01	3.78e-04
Trichloroethene	06-MW-04	1994	1.23e+01	7.68e-01	7.29e-03
Vinyl Chloride	G94-09-MW-01	1994	1.30e-01	1.10e-02	1.36e-06
Xylene (total)	09-MW-10-01	1992	9.90e+03	4.63e+01	2.74e-02
West Unit (Waste Accumulation area and Power Plant)					
1,2-Dichloroethane	G94-06-MW-05	1994	1.18e+00	5.52e-03	1.12e-05
4,4'-DDT	11-MW-01-01	1992	2.10e-02	2.42e-03	3.93e-07
alpha-BHC	06-MW-03-03	1993	1.73e-02	2.70e-05	2.61e-08
Arsenic	11-MW-02-01	1992	5.00e+00	6.40e-01	9.51e-05
Barium	11-MW-02-01	1992	4.40e+02	5.63e+01	2.77e-03
Benzene	G94-06-MW-05	1994	3.90e-01	1.81e-09	9.78e-06
Benzoic acid	11-MW-02-01	1992	4.00e+00	5.12e-01	5.08e-02
beta-BHC	11-MW-02-01	1992	4.40e-02	4.72e-05	3.67e-08
bis(2-Ethylhexyl)phthalate	G94-06-MW-05	1994	1.51e+00	9.14e-03	2.21e-06
Bromochloromethane	06-MW-03-03	1993	1.83e+01	2.34e+00	4.61e-03
Calcium	11-MW-01-01	1992	2.60e+05	3.33e+04	6.20e-01
Chloromethane	G94-06-MW-05	1994	6.80e-01	5.20e-11	2.30e-09
cis-1,2-Dichloroethene	G94-06-MW-03	1994	1.13e+00	1.45e-01	5.13e-03
Cobalt	11-MW-02-01	1992	3.20e+01	4.10e+00	7.63e-05
delta-BHC	11-MW-02-01	1992	3.60e-02	1.20e-05	2.24e-10
Dibromomethane	G94-06-MW-05	1994	2.20e-01	1.68e-11	8.30e-10
Dieldrin	G94-06-MW-05	1994	9.10e-03	6.72e-04	1.19e-07
Endosulfan sulfate	G94-06-MW-03	1994	2.00e-04	2.56e-05	1.33e-07
Endrin aldehyde	G94-06-MW-05	1994	1.10e-03	1.41e-04	9.96e-08
gamma-BHC	11-MW-02-01	1992	4.90e-02	4.43e-05	3.29e-08
Heptachlor	G94-06-MW-05	1994	2.50e-03	1.40e-99	2.03e-45
Iron	11-MW-02-01	1992	2.60e+03	3.33e+02	7.04e-01
Lead	11-MW-02-01	1992	1.80e+01	2.30e+00	2.05e-04
Magnesium	11-MW-01-01	1992	4.30e+04	5.50e+03	1.03e-01
Manganese	11-MW-02-01	1992	3.00e+04	3.84e+03	7.15e-02
Methoxychlor	G94-06-MW-05	1994	3.58e-02	1.76e-04	2.08e-07
Nickel	11-MW-02-01	1992	4.20e+01	5.38e+00	1.00e-04

Table C-2
(Continued)

Analyte	Location	Year	Result (ppb)	Shoreline Conc. (ppb)	River Conc. within 5ft mixing zone (ppb)
Potassium	11-MW-01-01	1992	5.90e+03	7.55e+02	0.0141
Selenium	11-MW-01-01	1992	7.00e+00	8.96e-01	2.94e-05
Sodium	G94-06-MW-05	1994	4.21e+04	5.39e+03	1.73e-01
Vinyl Chloride	G94-06-MW-03	1994	2.00e-02	1.69e-03	1.02e-06
Zinc	G94-06-MW-05	1994	4.83e+01	6.18e+00	1.15e-04

APPENDIX D

Air Emissions Estimating and Dispersion Modeling in Ambient Air

APPENDIX D
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D.1 INTRODUCTION

Emission rates of chemical compounds due to volatilization and wind entrainment of contaminated dust were estimated using predictive equations recommended by the USEPA. The emission rates were then input into a USEPA-approved computer dispersion model to estimate chemical concentrations in the atmosphere at identified receptor locations.

D.2 EMISSION ESTIMATES

Emission rates of chemicals of potential concern (COPCs) in the contaminated areas of the various sites were calculated using emission rate equations applicable to various emission mechanisms. The various types of mechanisms that were considered include:

- Volatilization of compounds from soil contamination(surface soil samples collected from the top two feet of soil);
- Volatilization of compounds from subsurface soil (contamination below two feet);
- Wind entrainment of contaminated surface soil; and
- Emissions from construction-related activities.

A chemical was evaluated for volatilization emissions if the following analytical methods were used during the sampling analysis - SW8010, SW8020, SW8240, and SW8260. All other chemicals were evaluated for entrained dust emission mechanisms only.

The various sites in the scope of this analysis include the POL Area, Fire Protection and Training Area, and West Unit Area. The West Unit area was further broken into Building 1700 Area, Building 1845 Area, Power Plant Area, JP-4 Fillstands Area, Waste

Accumulation Area, and Million Gallon Hill Area. These areas were divided on the basis of homogenous emission characteristics (e.g., COPC concentrations, depth of contamination, soil type, and geographic proximity).

Each of the emission mechanisms and the equations used to calculate emission rates are discussed below.

D.2.1 Volatilization from Surface Contamination

Emission from areas where the contamination is present in the soil surface (top 0 - 1 feet) were estimated using the Thibodeaux and Hwang model (USEPA, 1993c) as shown below:

$$ER = \frac{2D\ C_1\ SA\ 10^4}{1_d + \left[\frac{2\ D\ C_1\ t}{C_s} + 1_d^2\right]^{\frac{1}{2}}}$$

where:

ER	=	average emission rate flux of compound I over time [g/sec/m2];
D	=	phase transfer coefficient [cm^2/sec];
C_1	=	liquid-phase concentration of I in soil [g/cm^3];
10^4	=	conversion factor [cm^2/m^2];
1_d	=	depth of dry zone at sampling time [cm] = 1 ; and
t	=	time since sampling occurred [sec] = 10 Months (it was assumed that all sampling activity ended in 9/94).

The phase transfer coefficient (D) is calculated as follows:

$$D = \frac{D_a E_A^{\frac{4}{3}} H}{R T}$$

where:

D_a	=	diffusion coefficient of compound I in air [cm^2/sec];
E_a	=	total soil porosity [unitless];
H	=	Henry's Law constant of compound I [atm-m^3/mol];
R	=	ideal gas constant, equal to 8.2×10^{-5} [atm-m^3/mol-°K]; and
T	=	absolute temperature [°K]. The average annual temperature at Galena was assumed to be 9.44°C.

Table D-1 presents the chemical specific constants and Table D-2 presents the site specific characteristics.

D.2.2 Volatilization from Subsurface Contamination

Emissions of volatile contaminants from subsurface soils were estimated. Subsurface soils are defined as being greater than two feet below ground level. The subsurface soil volatile contaminant emission rates were estimated using Farmer's equation as presented in a USEPA Superfund guidance document (USEPA, 1993c):

$$ER = \frac{D_a\ C_g\ E_a^{\frac{4}{3}}\ X_{mol}\ 10^{-12}}{0.01\ L}$$

Table D-1

Chemical Properties of COPCs

CAS No	Chemical Name	Molecular Weight	Vapor Pressure (mm - Hg)	Diffusivity in Air (cm^2/sec)	Henry's Law Constant (atm-m^3/mol)
591-78-6	2-Hexanone	100	1.15	0.6	*
71-43-2	Benzene	78.12	42.06	0.09	0.55
79-34-5	1,1,2,2-Tetrachloroethane	167.85	6.5	0.07	0.025

*Henry's Law constant is used to calculate the phase transfer coefficient. Since a value for 2-hexanone could not be found, the default phase transfer coefficient value of 0.15 cm^2 / sec was used (as per USEPA Superfund guidance document (USEPA, 1993c)).

Table D-2
Site Specific Properties

Site	Erodibility (unitless)	Silt Content (%)	Moisture Content
Building 1700	90	1.11	0.1232
Building 1845	90	1.11	0.1232
Building 1850	90	1.11	0.1232
Fire Training Area	205	25.65	0.1189
JP-4 Fill Stands	90	1.11	0.1232
Million Gallon Hill	90	1.11	0.1232
POL Area	90	1.11	0.1395
Power Plant	47.5	2.2	0.1232
Waste Accumulation Area	90	1.11	0.1232

where:

ER	=	emission rate flux of compound I [g/sec/m2];
D_a	=	diffusivity of compound in air [cm^2/sec];
C_g	=	saturation vapor concentration of compound I [$\mu g/m^3$];
E_a	=	air-filled soil porosity [unitless];
X_{mol}	=	mole fraction of compound I in the waste [mol/mol];
10^{-12}	=	conversion factor [g/cm^3 / $\mu g/m^3$];
0.01	=	conversion factor [m/cm]; and
L	=	depth of soil cover [m] = 1.0, as per USEPA Superfund guidance document (USEPA, 1993c)

The saturation vapor concentration term, C_g, is calculated as follows:

$$C_g = \frac{P \ MW \ 10^{12}}{(R \ T)}$$

where:

P	=	vapor pressure of compound I [mm Hg];
MW	=	molecular weight of compound I [g/mol];
10^{12}	=	conversion factor [$\mu g/g * cm^3/m^3$];
R	=	ideal gas constant 62,361 [mm Hg-cm^3/mol-°K]; and
T	=	absolute temperature [°K]. The average annual temperature at Galena was assumed to be 9.44°C.

Since there were insufficient data to characterize the contents of the waste in the soil to determine mole fractions of individual chemicals in the waste, the mole fraction was assumed to be the weight fraction of the contaminant detected in the soil.

The air filled soil porosity, E_a, can be calculated as follows:

$$E_a = 1 - \left[\frac{\beta + (\beta)\left(X_{H_2O}\right)}{\rho}\right]$$

where:

β	=	bulk density of soil [g/cm^3] = 1.5;
X_H2^O	=	moisture fraction in soil [wt. % moisture/100]; and
ρ	=	particle density of soil [g/cm^3] = 2.65.

The values for soil bulk density and particle density are defaults recommended in USEPA Superfund guidance document (USEPA, 1993c).

D.2.3 Wind Blown Dust

Contaminants can enter the atmosphere due to wind entrainment of contaminated surface soil. Wind erosion was assumed to occur only from areas that are not paved. The presence of vegetation, which would serve to minimize dust emissions, was not considered.

The wind-blown dust equation (Bohn et al, 1978), presented below, was used to calculate the total dust emissions.

$$E = 3400 \frac{\frac{e}{50} \times \frac{s}{15} \times \frac{f}{25}}{\left(\frac{P-E}{50} \right)^2}$$

where:

E	=	emission rate (lb/acre-yr);
e	=	surface erodability (unitless);
s	=	silt content (%);
f	=	percentage of time wind exceeds 12 mph = 8.5; and
P-E	=	Thornwaite's Precipitation-Evaporation Index (unitless) = 45.07 for the Galena area.

The emission rate of each nonvolatile chemical was calculated by multiplying the dust emission rate by the measured concentration of the chemical in the surface soil (0-2 feet).

The surface erodability was determined for the site and is defined as the percentage of soil particles not passing a No. 10 sieve. The silt content was based on the percentage of soil particles passing a No. 200 sieve. The surface erobility and silt content was estimated from site specific data.

D.2.4 Emissions from Construction-Related Activities

Construction activity was assumed to involve excavation. Thus, emissions were estimated from the higher of the surface and subsurface soil sampling results for normal emission mechanisms as described above for volatilization from surface contamination (Section D.2.1) and for dust (Section D.2.3). Additionally, emission factors for heavy construction activities were used. The emission factor is based on field measurements of suspended dust emissions

from apartment and shopping center construction projects. The factor is 1.2 tons/acre per month of heavy construction activity (Section 11.2.4, AP-42, U.S. EPA, 1985). Note again that it is assumed that all contaminated subsurface soil will be exposed to the surface and equations for emissions from surface contamination were used.

D.2.5 Emissions from Contaminated Groundwater

The concentrations of volatile compounds detected in the groundwater are in the ppm range. The volatilization rate is very low at these concentration levels. Additionally the average depth at which groundwater is found at Galena is 10 feet. Hence emissions, due to contaminated groundwater, will have to traverse a soil buffer of 10 feet before they reach the atmosphere and will be relatively insignificant compared to emissions due to other mechanisms.

Table D-3 lists the highest representative concentration (the lower of the maximum detected concentration or the 95% Upper Confidence Limit on the mean) for the five Galena sites that are the subject of this baseline risk assessment. Note that the Southeast Runway Fuel Spill site and the Control Tower Drum Storage Area, South are addressed in the Volume 4 Addendum. This table also lists the draft USEPA soil screening levels for transfers from soil to air. Although specific to soil rather than groundwater, these soil screening levels provide a mechanism for evaluating the potential significance of groundwater concentrations. The soil screening levels apply to emissions from surface soils and are protective of residential exposures.

Almost all groundwater concentrations are well below the chemical-specific soil screening level for transfers from soil to air, indicating that emissions from groundwater, which must traverse a soil buffer before reaching the air, are not likely to be a cause for concern. Concentrations of only two chemicals exceed the soil screening level: benzene at the POL Tank Farm and at Million Gallon Hill in the West Unit and trichloroethene at Bldg. 1845 in the West Unit. Benzene emissions to the air were estimated based on much higher soil concentrations and the relative contribution of emissions from groundwater is minimal by comparison. Trichloroethene concentrations exceed the soil screening level by a factor of only 2.5; given the

Table D-3
VOCs Detected in Groundwater (mg/L)

Chemicals	Groundwater Concentration (ppm)[a]					Soil Screening Level for Transfer from Soil to Air[b] ppm
	Fire Protection Training Area	POL Tank Farm	West Unit[c]	Southeast Runway Fuel Spill Area	Control Tower Drum Storage Area	
Acetone	---	0.14	0.25	---	---	62000
Benzene	0.22	**19[f]**	**3.4[f]**	0.058	---	0.5
Bromochloromethane	0.020	0.019	2.1[d]	---	---	---[e]
Chlorobenzene	---	0.014	---	---	---	94
Chloroform	---	---	0.0020[d]	0.000037	---	0.2
Chloromethane	0.00051	0.026	0.015	0.010	---	0.063
Dibromomethane	0.00021	0.00016	0.019	---	0.00021	---[e]
1,2-Dichloroethane	0.0013	0.022	0.0012[d]	0.0039	0.0064	0.3
1,1-Dichloroethene	---	0.013	0.0057[d]	---	---	0.04
1,2-Dichloroethene(cis)	---	---	2.2[d]	---	0.023	1500
1,2-Dichloroethene(trans)	---	---	0.19[d]	---	---	3600
Ethylbenzene	---	0.46	0.12	---	---	260
Methylene chloride	---	0.12	0.020	---	---	7
Tetrachloroethene	---	---	0.00032[d]	---	---	11
Toluene	---	10	0.37	---	---	520
1,1,2-Trichloroethane	---	---	0.0013	---	---	0.8
Trichloroethene	---	0.0034	**7.6[d]**	0.00021	0.0093	3
Vinyl chloride	---	---	0.00074[d]	---	---	0.002
Xylene	---	38	1.9	---	---	320

[a]Highest representative concentration (the lower of the maximum detected concentration or the 95% Upper Confidence Limit on the mean).
[b]Draft USEPA soil screening level, as listed in USEPA Region III Risk-Based Concentration Table (October 20, 1995).
[c]Highest representative concentration in West Unit listed. Unless otherwise noted, highest concentrations were detected in groundwater at the Million Gallon Hill source area.
[d]Listed concentration from the Bldg. 1845 source area.
[e]Toxicity values not available for derivation of screening level.
[f]Emissions to the air were estimated based on much higher soil concentrations (POL: 340 ppm, West Unit: 68 ppm).

Note: Values in bold print exceed the soil screening level for transfer from soil to air.

soil buffer and the industrial (non-residential) land use in the West Unit, these concentrations are not likely to be a cuase for concern.

This issue was discussed at the comment resolution meeting held to discuss and resolve ADEC comments on the draft BRA report, and ADEC agreed that it was not necessary to estimate VOC emissions from groundwater (USAF, 1996).

D.2.6 Emission Rate Summary

Table D-4 presents the emissions rate fluxes from the various emission mechanisms described for each site of interest at Galena. Table D-5 presents the emissions rate fluxes for the construction worker scenario.

D.3 MODELING METHODOLOGY

The air dispersion modeling was performed in accordance with the guidance provided in the EPA document, *Guideline on Air Quality Models (Revised),* September 1990. The draft version of ISCST2 was used to determine contaminant transport in the ambient air. The draft version incorporates new area source algorithms that allow concentrations to be computed for receptors that are with in the region of the area source that is being modeled. Three scenarios were modeled general exposure, year round onsite worker, and construction worker exposures. All modeling was performed using unit emissions rates.

Each area of contamination was represented by a group of area sources. The size and location of the area sources are illustrated in Figures D-1 and D-2. The maximum impacts for normal exposures were determined from each of the contamination areas (west unit, POL, and FTPA) and from all the areas as a group. For the year round onsite worker the maximum

Table D-4
Predicted Emissions Fluxes

Site	CAS No	Chemical	Emission Mechanism	Soil Concentration (mg/kg)	Predicted Emissions Flux (gms/sec/m^2)
Building 1700	71-43-2	Benzene	Subsurface Volatilization	6.80e+01	3.07e-08
Building 1700	71-43-2	Benzene	Surface Volatilization	6.60e+00	3.69e-06
Building 1700	7439-92-1	Lead	Dust Emissions	7.68e+01	5.17e-11
Building 1700	7440-38-2	Arsenic	Dust Emissions	8.09e+00	5.45e-12
Building 1700	91-57-6	2-Methylnaphthalene	Dust Emissions	4.40e-02	2.96e-14
Fire Training Area	1024-57-3	Heptachlor epoxide	Dust Emissions	3.06e-03	1.08e-13
Fire Training Area	191-24-2	Benzo(g,h,i)perylene	Dust Emissions	4.70e-02	1.67e-12
Fire Training Area	208-96-8	Acenaphthylene	Dust Emissions	1.45e-01	5.13e-12
Fire Training Area	309-00-2	Aldrin	Dust Emissions	9.43e-03	3.34e-13
Fire Training Area	3268-87-9	OCDD	Dust Emissions	6.54e-04	2.32e-14
Fire Training Area	35822-46-9	HpCDD Totals	Dust Emissions	1.00e-04	3.55e-15
Fire Training Area	50-29-3	4,4'-DDT	Dust Emissions	4.00e-01	1.42e-11
Fire Training Area	50-32-8	Benzo(a)pyrene	Dust Emissions	1.73e-02	6.13e-13
Fire Training Area	591-78-6	2-Hexanone	Surface Volatilization	2.42e+00	6.47e-07
Fire Training Area	71-43-2	Benzene	Subsurface Volatilization	2.82e+01	1.29e-08
Fire Training Area	7439-92-1	Lead	Dust Emissions	5.99e+01	2.12e-09
Fire Training Area	85-01-8	Phenanthrene	Dust Emissions	8.08e+00	2.87e-10
JP-4 Fill Stands	191-24-2	Benzo(g,h,i)perylene	Dust Emissions	2.16e+00	1.46e-12
JP-4 Fill Stands	193-39-5	Indeno(1,2,3-cd)pyrene	Dust Emissions	1.77e+00	1.19e-12
JP-4 Fill Stands	205-99-2	Benzo(b)fluoranthene	Dust Emissions	5.05e+00	3.40e-12
JP-4 Fill Stands	207-08-9	Benzo(k)fluoranthene	Dust Emissions	4.15e+00	2.80e-12
JP-4 Fill Stands	208-96-8	Acenaphthylene	Dust Emissions	1.69e-01	1.14e-13
JP-4 Fill Stands	218-01-9	Chrysene	Dust Emissions	4.50e+00	3.03e-12
JP-4 Fill Stands	50-29-3	4,4'-DDT	Dust Emissions	2.40e+00	1.62e-12
JP-4 Fill Stands	50-32-8	Benzo(a)pyrene	Dust Emissions	3.61e+00	2.43e-12
JP-4 Fill Stands	53-70-3	Dibenz(a,h)anthracene	Dust Emissions	1.01e+00	6.78e-13

Table D-4
(Continued)

Site	CAS No	Chemical	Emission Mechanism	Soil Concentration (mg/kg)	Predicted Emissions Flux (gms/sec/m^2)
JP-4 Fill Stands	56-55-3	Benz(a)anthracene	Dust Emissions	4.45e+00	3.00e-12
JP-4 Fill Stands	591-78-6	2-Hexanone	Subsurface Volatilization	7.27e-02	7.39e-12
JP-4 Fill Stands	71-43-2	Benzene	Subsurface Volatilization	1.20e+01	5.43e-09
JP-4 Fill Stands	72-54-8	4,4'-DDD	Dust Emissions	8.02e-01	5.41e-13
JP-4 Fill Stands	72-55-9	4,4'-DDE	Dust Emissions	3.73e-01	2.51e-13
JP-4 Fill Stands	7439-92-1	Lead	Dust Emissions	3.33e+01	2.24e-11
JP-4 Fill Stands	79-34-5	1,1,2,2-Tetrachloroethane	Subsurface Volatilization	1.44e+00	1.64e-10
JP-4 Fill Stands	85-01-8	Phenanthrene	Dust Emissions	4.94e+00	3.33e-12
JP-4 Fill Stands	87-86-5	Pentachlorophenol	Dust Emissions	9.77e-01	6.58e-13
JP-4 Fill Stands	91-57-6	2-Methylnaphthalene	Dust Emissions	4.84e-01	3.26e-13
Million Gallon Hill	191-24-2	Benzo(g,h,i)perylene	Dust Emissions	1.87e-01	1.26e-13
Million Gallon Hill	193-39-5	Indeno(1,2,3-cd)pyrene	Dust Emissions	1.72e-01	1.16e-13
Million Gallon Hill	205-99-2	Benzo(b)fluoranthene	Dust Emissions	7.17e-01	4.83e-13
Million Gallon Hill	50-32-8	Benzo(a)pyrene	Dust Emissions	3.21e-01	2.16e-13
Million Gallon Hill	56-55-3	Benz(a)anthracene	Dust Emissions	1.47e-01	9.89e-14
Million Gallon Hill	7439-92-1	Lead	Dust Emissions	1.31e+03	8.80e-10
Million Gallon Hill	85-01-8	Phenanthrene	Dust Emissions	1.64e-01	1.10e-13
Million Gallon Hill	91-57-6	2-Methylnaphthalene	Dust Emissions	3.11e-02	2.10e-14
POL Area	191-24-2	Benzo(g,h,i)perylene	Dust Emissions	3.41e-02	2.40e-14
POL Area	205-99-2	Benzo(b)fluoranthene	Dust Emissions	3.96e-02	2.79e-14
POL Area	50-32-8	Benzo(a)pyrene	Dust Emissions	3.19e-02	2.24e-14
POL Area	53-70-3	Dibenz(a,h)anthracene	Dust Emissions	1.64e-02	1.16e-14
POL Area	56-55-3	Benz(a)anthracene	Dust Emissions	4.73e-02	3.33e-14
POL Area	60-57-1	Dieldrin	Dust Emissions	1.17e-02	8.24e-15
POL Area	71-43-2	Benzene	Subsurface Volatilization	3.40e+02	1.49e-07
POL Area	7439-92-1	Lead	Dust Emissions	8.56e+01	6.03e-11

Table D-4
(Continued)

Site	CAS No	Chemical	Emission Mechanism	Soil Concentration (mg/kg)	Predicted Emissions Flux (gms/sec/m^2)
POL Area	85-01-8	Phenanthrene	Dust Emissions	3.21e-01	2.26e-13
POL Area	91-57-6	2-Methylnaphthalene	Dust Emissions	1.19e+01	8.37e-12
Power Plant	319-84-6	alpha-BHC	Dust Emissions	1.60e-02	1.13e-14
Power Plant	591-78-6	2-Hexanone	Surface Volatilization	1.40e+00	3.87e-07
Power Plant	60-57-1	Dieldrin	Dust Emissions	8.80e-03	6.20e-15
Power Plant	7429-90-5	Aluminum	Dust Emissions	1.10e+04	7.75e-09
Power Plant	7439-92-1	Lead	Dust Emissions	4.32e+01	3.04e-11
Power Plant	7439-96-5	Manganese (food)	Dust Emissions	4.40e+02	3.10e-10
Power Plant	7440-41-7	Beryllium	Dust Emissions	2.80e-01	1.97e-13
Power Plant	91-57-6	2-Methylnaphthalene	Dust Emissions	2.40e+01	1.69e-11
Waste Accumulation Area	1024-57-3	Heptachlor epoxide	Dust Emissions	1.40e-03	9.43e-16
Waste Accumulation Area	191-24-2	Benzo(g,h,i)perylene	Dust Emissions	1.94e-01	1.31e-13
Waste Accumulation Area	193-39-5	Indeno(1,2,3-cd)pyrene	Dust Emissions	1.75e-01	1.18e-13
Waste Accumulation Area	205-99-2	Benzo(b)fluoranthene	Dust Emissions	4.00e-01	2.69e-13
Waste Accumulation Area	309-00-2	Aldrin	Dust Emissions	8.89e-03	5.99e-15
Waste Accumulation Area	50-29-3	4,4'-DDT	Dust Emissions	6.17e+00	4.15e-12
Waste Accumulation Area	50-32-8	Benzo(a)pyrene	Dust Emissions	3.75e-01	2.52e-13
Waste Accumulation Area	53-70-3	Dibenz(a,h)anthracene	Dust Emissions	1.25e-01	8.40e-14
Waste Accumulation Area	56-55-3	Benz(a)anthracene	Dust Emissions	4.68e-01	3.15e-13
Waste Accumulation Area	58-89-9	gamma-BHC	Dust Emissions	8.31e-03	5.60e-15
Waste Accumulation Area	60-57-1	Dieldrin	Dust Emissions	2.15e-01	1.45e-13
Waste Accumulation Area	72-54-8	4,4'-DDD	Dust Emissions	4.61e+00	3.10e-12
Waste Accumulation Area	72-55-9	4,4'-DDE	Dust Emissions	3.49e-01	2.35e-13
Waste Accumulation Area	7439-92-1	Lead	Dust Emissions	1.84e+02	1.24e-10
Waste Accumulation Area	85-01-8	Phenanthrene	Dust Emissions	6.53e-01	4.40e-13
Waste Accumulation Area	91-57-6	2-Methylnaphthalene	Dust Emissions	1.63e-02	1.09e-14

Table D-5
Predicted Emissions Fluxes (Construction Scenario)

Site	CAS No	Chemical	Emission Mechanism*	Soil Concentration (mg/kg)	Predicted Emissions Flux (gms/sec/m^2)
Building 1700	117-81-7	bis(2-Ethylhexyl)phthalat	Dust Emissions	2.29e+01	0
Building 1700	71-43-2	Benzene	Volatilization	6.80e+01	0.0000379
Building 1700	7439-92-1	Lead	Dust Emissions	7.68e+01	7.913e-09
Building 1700	7440-38-2	Arsenic	Dust Emissions	8.23e+00	8.480e-10
Building 1700	85-01-8	Phenanthrene	Dust Emissions	7.36e-01	7.583e-11
Building 1700	91-57-6	2-Methylnaphthalene	Dust Emissions	5.67e+01	5.842e-09
Building 1845	50-29-3	4,4'-DDT	Dust Emissions	3.70e+00	3.812e-10
Building 1845	72-54-8	4,4'-DDD	Dust Emissions	1.00e+01	1.030e-09
Building 1845	7429-90-5	Aluminum	Dust Emissions	9.80e+03	0.000001
Building 1845	7439-92-1	Lead	Dust Emissions	8.10e+00	8.346e-10
Building 1845	7439-96-5	Manganese (food)	Dust Emissions	4.80e+02	4.946e-08
Building 1845	7440-38-2	Arsenic	Dust Emissions	9.30e+00	9.582e-10
Building 1845	7440-41-7	Beryllium	Dust Emissions	2.60e-01	2.679e-11
Building 1845	91-57-6	2-Methylnaphthalene	Dust Emissions	1.10e-01	1.133e-11
Fire Training Area	1024-57-3	Heptachlor epoxide	Dust Emissions	3.06e-03	4.211e-13
Fire Training Area	191-24-2	Benzo(g,h,i)perylene	Dust Emissions	9.30e-02	1.282e-11
Fire Training Area	205-99-2	Benzo(b)fluoranthene	Dust Emissions	1.90e-01	2.617e-11
Fire Training Area	208-96-8	Acenaphthylene	Dust Emissions	1.45e-01	1.995e-11
Fire Training Area	309-00-2	Aldrin	Dust Emissions	9.43e-03	1.299e-12
Fire Training Area	3268-87-9	OCDD	Dust Emissions	6.54e-04	9.006e-14
Fire Training Area	35822-46-9	HpCDD Totals	Dust Emissions	1.00e-04	1.378e-14
Fire Training Area	50-29-3	4,4'-DDT	Dust Emissions	4.00e-01	5.512e-11
Fire Training Area	50-32-8	Benzo(a)pyrene	Dust Emissions	2.99e-01	4.123e-11
Fire Training Area	53-70-3	Dibenz(a,h)anthracene	Dust Emissions	1.60e-02	2.205e-12
Fire Training Area	56-55-3	Benz(a)anthracene	Dust Emissions	4.43e-01	6.098e-11

Table D-5
(Continued)

Site	CAS No	Chemical	Emission Mechanism*	Soil Concentration (mg/kg)	Predicted Emissions Flux (gms/sec/m^2)
Fire Training Area	591-78-6	2-Hexanone	Volatilization	2.42e+00	0.0000006
Fire Training Area	71-43-2	Benzene	Volatilization	2.82e+01	0.0000157
Fire Training Area	7439-92-1	Lead	Dust Emissions	5.99e+01	8.257e-09
Fire Training Area	85-01-8	Phenanthrene	Dust Emissions	8.08e+00	1.114e-09
JP-4 Fill Stands	191-24-2	Benzo(g,h,i)perylene	Dust Emissions	2.16e+00	2.228e-10
JP-4 Fill Stands	193-39-5	Indeno(1,2,3-cd)pyrene	Dust Emissions	1.77e+00	1.826e-10
JP-4 Fill Stands	205-99-2	Benzo(b)fluoranthene	Dust Emissions	5.05e+00	5.204e-10
JP-4 Fill Stands	207-08-9	Benzo(k)fluoranthene	Dust Emissions	4.15e+00	4.278e-10
JP-4 Fill Stands	208-96-8	Acenaphthylene	Dust Emissions	1.69e-01	1.738e-11
JP-4 Fill Stands	218-01-9	Chrysene	Dust Emissions	4.50e+00	4.637e-10
JP-4 Fill Stands	50-29-3	4,4'-DDT	Dust Emissions	2.40e+00	2.472e-10
JP-4 Fill Stands	50-32-8	Benzo(a)pyrene	Dust Emissions	3.61e+00	3.723e-10
JP-4 Fill Stands	53-70-3	Dibenz(a,h)anthracene	Dust Emissions	1.01e+00	1.037e-10
JP-4 Fill Stands	56-55-3	Benz(a)anthracene	Dust Emissions	4.45e+00	4.582e-10
JP-4 Fill Stands	591-78-6	2-Hexanone	Volatilization	7.27e-02	1.944e-08
JP-4 Fill Stands	71-43-2	Benzene	Volatilization	1.20e+01	0.0000067
JP-4 Fill Stands	72-54-8	4,4'-DDD	Dust Emissions	8.02e-01	8.268e-11
JP-4 Fill Stands	72-55-9	4,4'-DDE	Dust Emissions	3.73e-01	3.842e-11
JP-4 Fill Stands	7439-92-1	Lead	Dust Emissions	3.33e+01	3.428e-09
JP-4 Fill Stands	79-34-5	1,1,2,2-Tetrachloroethane	Volatilization	1.44e+00	0.0000001
JP-4 Fill Stands	85-01-8	Phenanthrene	Dust Emissions	4.94e+00	5.093e-10
JP-4 Fill Stands	87-86-5	Pentachlorophenol	Dust Emissions	9.77e-01	1.007e-10
JP-4 Fill Stands	91-57-6	2-Methylnaphthalene	Dust Emissions	2.64e+01	2.721e-09
Million Gallon Hill	191-24-2	Benzo(g,h,i)perylene	Dust Emissions	1.87e-01	1.926e-11
Million Gallon Hill	193-39-5	Indeno(1,2,3-cd)pyrene	Dust Emissions	1.72e-01	1.768e-11

Table D-5
(Continued)

Site	CAS No	Chemical	Emission Mechanism*	Soil Concentration (mg/kg)	Predicted Emissions Flux (gms/sec/m^2)
Million Gallon Hill	205-99-2	Benzo(b)fluoranthene	Dust Emissions	7.17e-01	7.387e-11
Million Gallon Hill	208-96-8	Acenaphthylene	Dust Emissions	8.21e-03	8.459e-13
Million Gallon Hill	50-32-8	Benzo(a)pyrene	Dust Emissions	3.21e-01	3.307e-11
Million Gallon Hill	53-70-3	Dibenz(a,h)anthracene	Dust Emissions	4.26e-02	4.392e-12
Million Gallon Hill	56-55-3	Benz(a)anthracene	Dust Emissions	1.47e-01	1.514e-11
Million Gallon Hill	7439-92-1	Lead	Dust Emissions	1.31e+03	0.0000001
Million Gallon Hill	85-01-8	Phenanthrene	Dust Emissions	1.64e-01	1.689e-11
Million Gallon Hill	91-57-6	2-Methylnaphthalene	Dust Emissions	9.89e-02	1.019e-11
POL Area	191-24-2	Benzo(g,h,i)perylene	Dust Emissions	3.41e-02	3.514e-12
POL Area	205-99-2	Benzo(b)fluoranthene	Dust Emissions	3.96e-02	4.081e-12
POL Area	50-32-8	Benzo(a)pyrene	Dust Emissions	3.19e-02	3.283e-12
POL Area	53-70-3	Dibenz(a,h)anthracene	Dust Emissions	1.64e-02	1.694e-12
POL Area	56-55-3	Benz(a)anthracene	Dust Emissions	4.73e-02	4.875e-12
POL Area	60-57-1	Dieldrin	Dust Emissions	1.17e-02	1.206e-12
POL Area	71-43-2	Benzene	Volatilization	3.40e+02	0.0001895
POL Area	7439-92-1	Lead	Dust Emissions	8.56e+01	8.824e-09
POL Area	85-01-8	Phenanthrene	Dust Emissions	3.21e-01	3.313e-11
POL Area	91-57-6	2-Methylnaphthalene	Dust Emissions	3.29e+01	3.386e-09
Power Plant	1024-57-3	Heptachlor epoxide	Dust Emissions	1.20e-02	1.237e-12
Power Plant	319-84-6	alpha-BHC	Dust Emissions	1.60e-02	1.649e-12
Power Plant	58-89-9	gamma-BHC	Dust Emissions	5.00e-02	5.153e-12
Power Plant	591-78-6	2-Hexanone	Volatilization	1.40e+00	0.0000004
Power Plant	60-57-1	Dieldrin	Dust Emissions	1.20e-02	1.237e-12
Power Plant	7429-90-5	Aluminum	Dust Emissions	1.10e+04	0.0000011
Power Plant	7439-92-1	Lead	Dust Emissions	4.32e+01	4.452e-09

Table D-5
(Continued)

Site	CAS No	Chemical	Emission Mechanism*	Soil Concentration (mg/kg)	Predicted Emissions Flux (gms/sec/m^2)
Power Plant	7439-96-5	Manganese (food)	Dust Emissions	4.40e+02	4.535e-08
Power Plant	7440-38-2	Arsenic	Dust Emissions	1.00e+01	1.031e-09
Power Plant	7440-41-7	Beryllium	Dust Emissions	3.10e-01	3.195e-11
Power Plant	91-57-6	2-Methylnaphthalene	Dust Emissions	2.40e+01	2.474e-09
Waste Accumulation Area	1024-57-3	Heptachlor epoxide	Dust Emissions	1.40e-03	1.442e-13
Waste Accumulation Area	191-24-2	Benzo(g,h,i)perylene	Dust Emissions	1.94e-01	1.996e-11
Waste Accumulation Area	193-39-5	Indeno(1,2,3-cd)pyrene	Dust Emissions	1.75e-01	1.808e-11
Waste Accumulation Area	205-99-2	Benzo(b)fluoranthene	Dust Emissions	4.00e-01	4.121e-11
Waste Accumulation Area	309-00-2	Aldrin	Dust Emissions	8.89e-03	9.163e-13
Waste Accumulation Area	50-29-3	4,4'-DDT	Dust Emissions	6.17e+00	6.354e-10
Waste Accumulation Area	50-32-8	Benzo(a)pyrene	Dust Emissions	3.75e-01	3.859e-11
Waste Accumulation Area	53-70-3	Dibenz(a,h)anthracene	Dust Emissions	1.25e-01	1.285e-11
Waste Accumulation Area	56-55-3	Benz(a)anthracene	Dust Emissions	4.68e-01	4.826e-11
Waste Accumulation Area	58-89-9	gamma-BHC	Dust Emissions	8.31e-03	8.566e-13
Waste Accumulation Area	60-57-1	Dieldrin	Dust Emissions	2.15e-01	2.211e-11
Waste Accumulation Area	72-54-8	4,4'-DDD	Dust Emissions	4.61e+00	4.749e-10
Waste Accumulation Area	72-55-9	4,4'-DDE	Dust Emissions	3.49e-01	3.597e-11
Waste Accumulation Area	7439-92-1	Lead	Dust Emissions	1.84e+02	1.897e-08
Waste Accumulation Area	85-01-8	Phenanthrene	Dust Emissions	6.53e-01	6.723e-11
Waste Accumulation Area	91-57-6	2-Methylnaphthalene	Dust Emissions	3.48e-02	3.590e-12

* Dust emissions mechanism emissions are sum of emissions due to wind blown dust and construction activity.

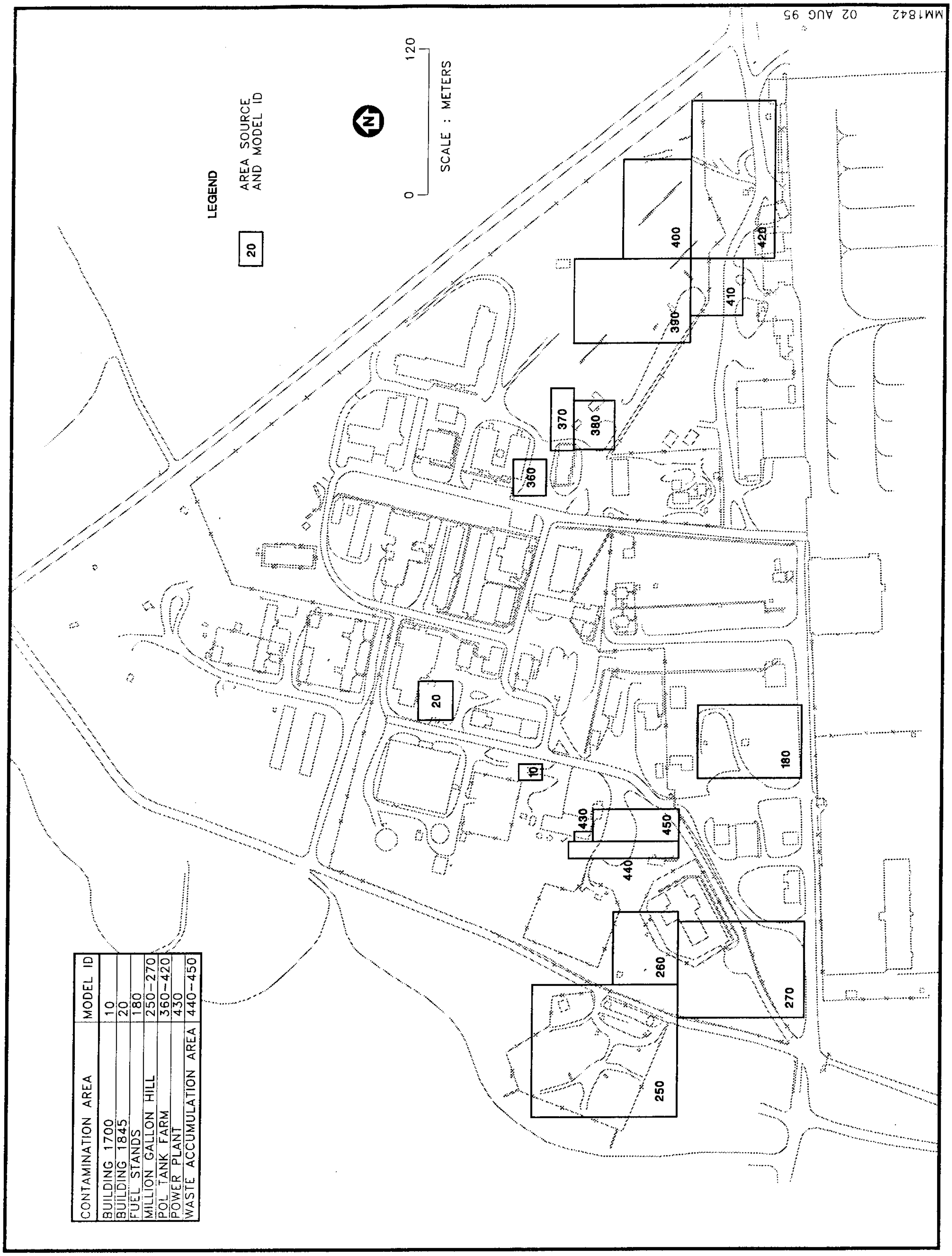

Figure D-1. Modeled Area Sources

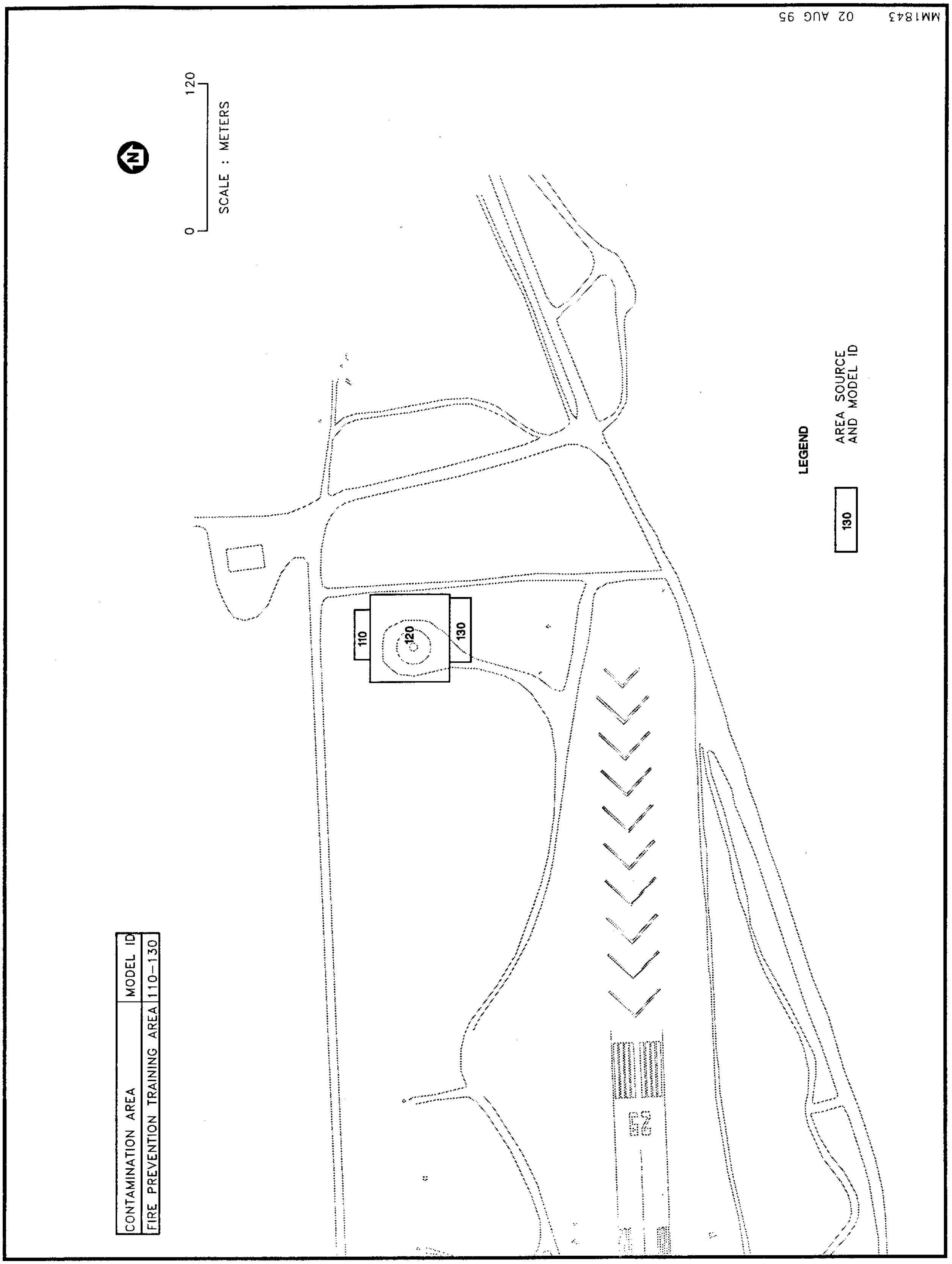

Figure D-2. Modeled Area Sources FPTA

impact on top of each area due to the emissions from each area were determined. The meteorological period for normal and on-base worker exposures was limited to April 1 through October 31. There are no emissions during the remaining 5 months of the year since the ground is frozen. For the construction worker exposures the maximum average 8-hour concentration over either a three month (6/1-8/31) or six month (4/1-9/30) period was determined. This was done by determining the 8-hour average concentrations for the hours of 8 AM to 4 PM for each day and then averaging these concentrations for either three months or six months at each receptor. The maximum averaged concentration on top of each area due to the emissions from each area was then chosen.

For input to ISCST2 draft, the 1991 pre-processed data compiled from the McGrath, Alaska surface observations, and mixing heights from the Fairbanks, AK, NWS surface and upper air observations were used. This is the most recently available data on the EPA SCRAM bulletin board. The location of all the receptors are illustrated in Figures D-3 to D-6. A file of the receptor locations and classifications is provide along with the model input and output files on the enclosed diskettes.

D.4 MODELING RESULTS

The results for the general exposure, year round on-base worker, and 3-month and 6-month construction worker exposures are provided in Tables D-6 through D-9, respectively.

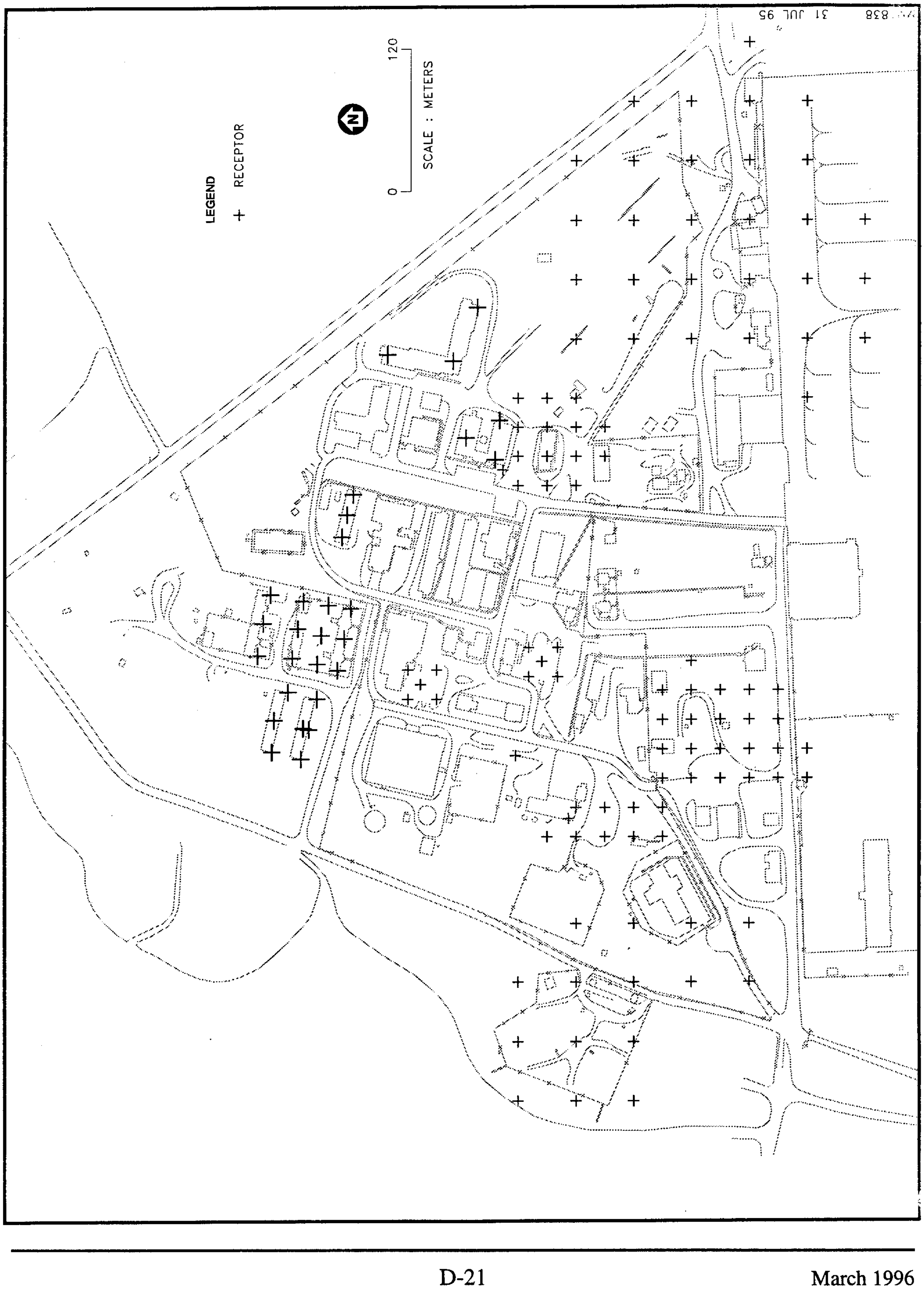

Figure D-3. On-Base Residential and Worker Receptors

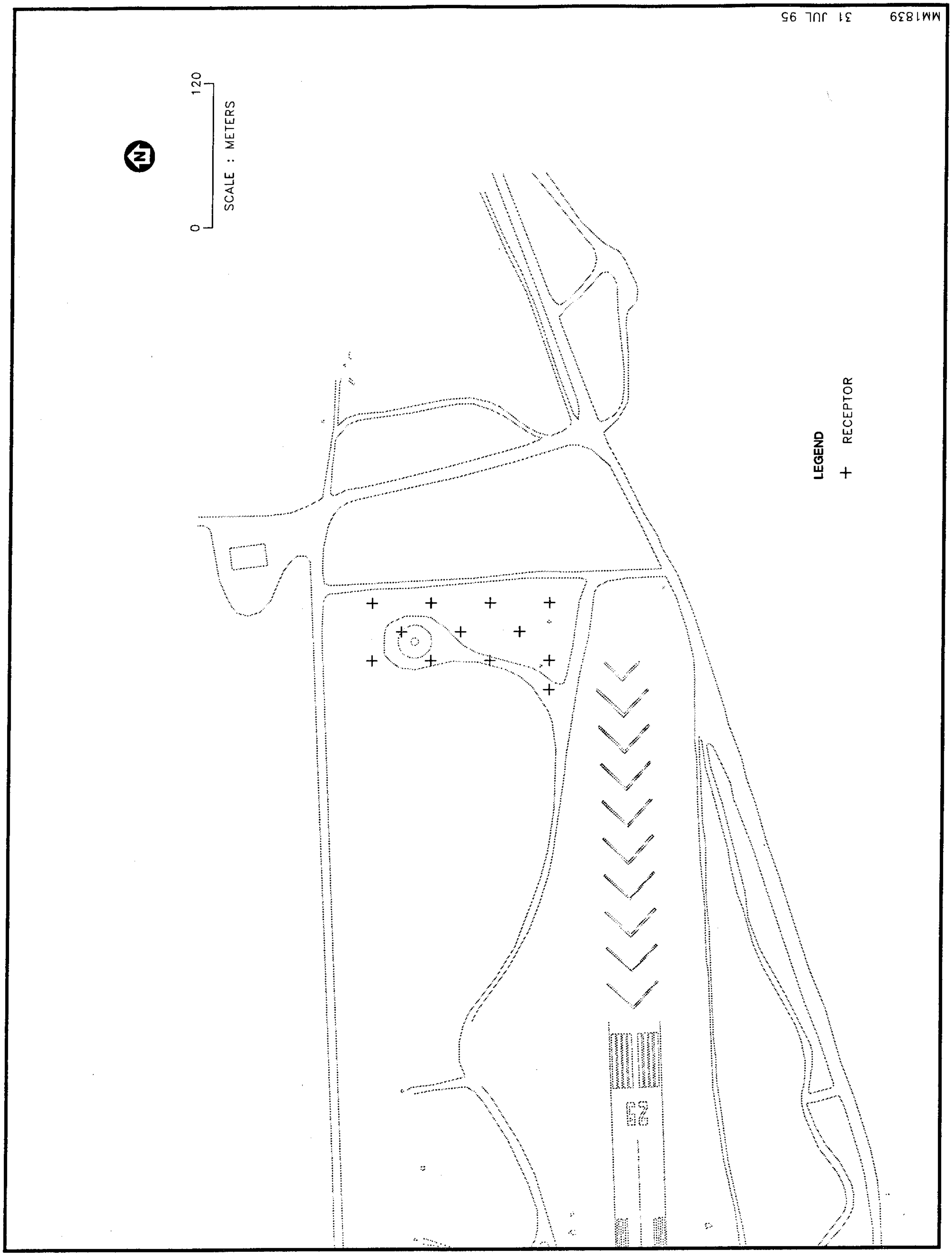

Figure D-4. Fire Protection Training Area Receptors

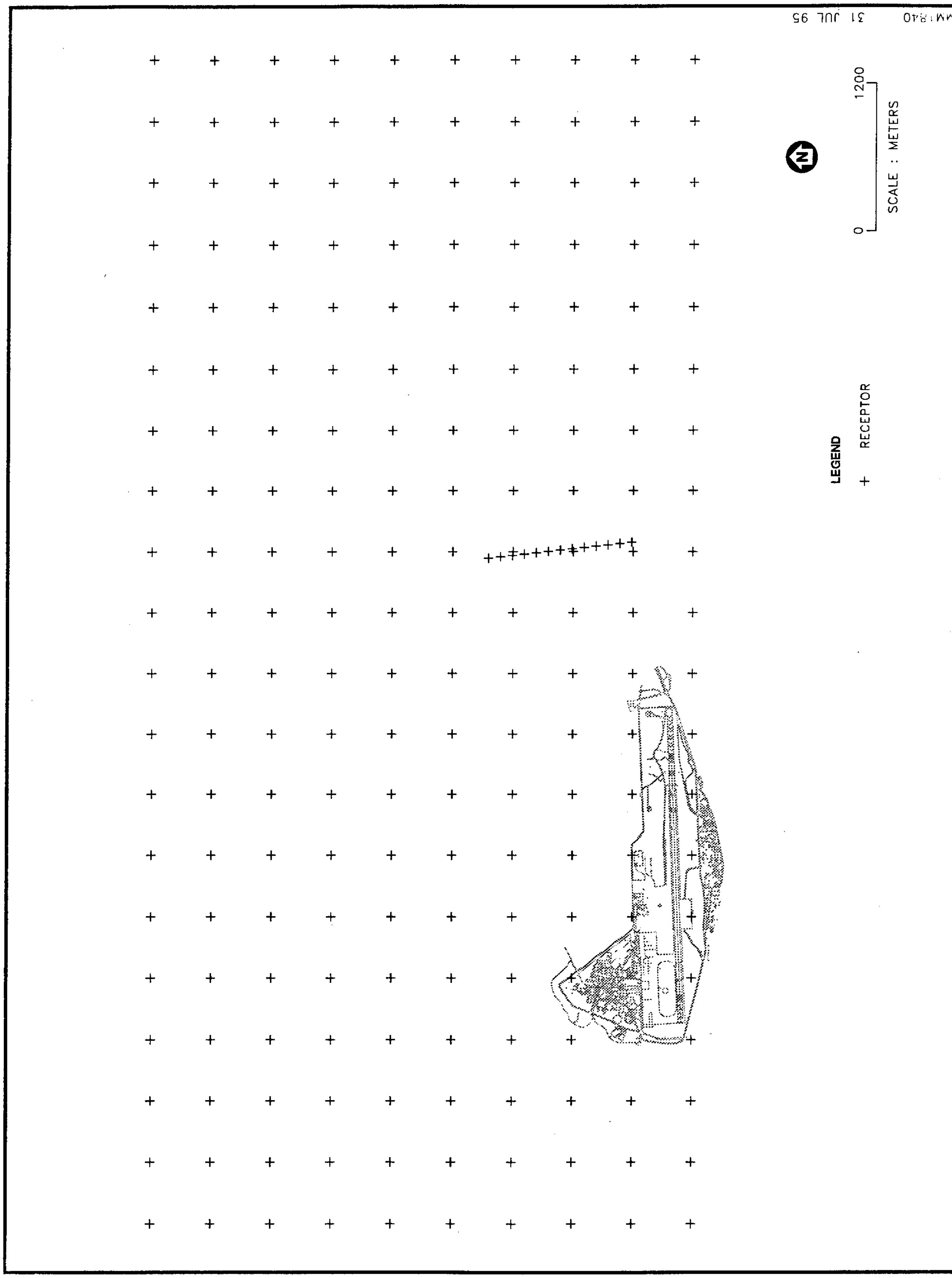

Figure D-5. Off-Site Receptors

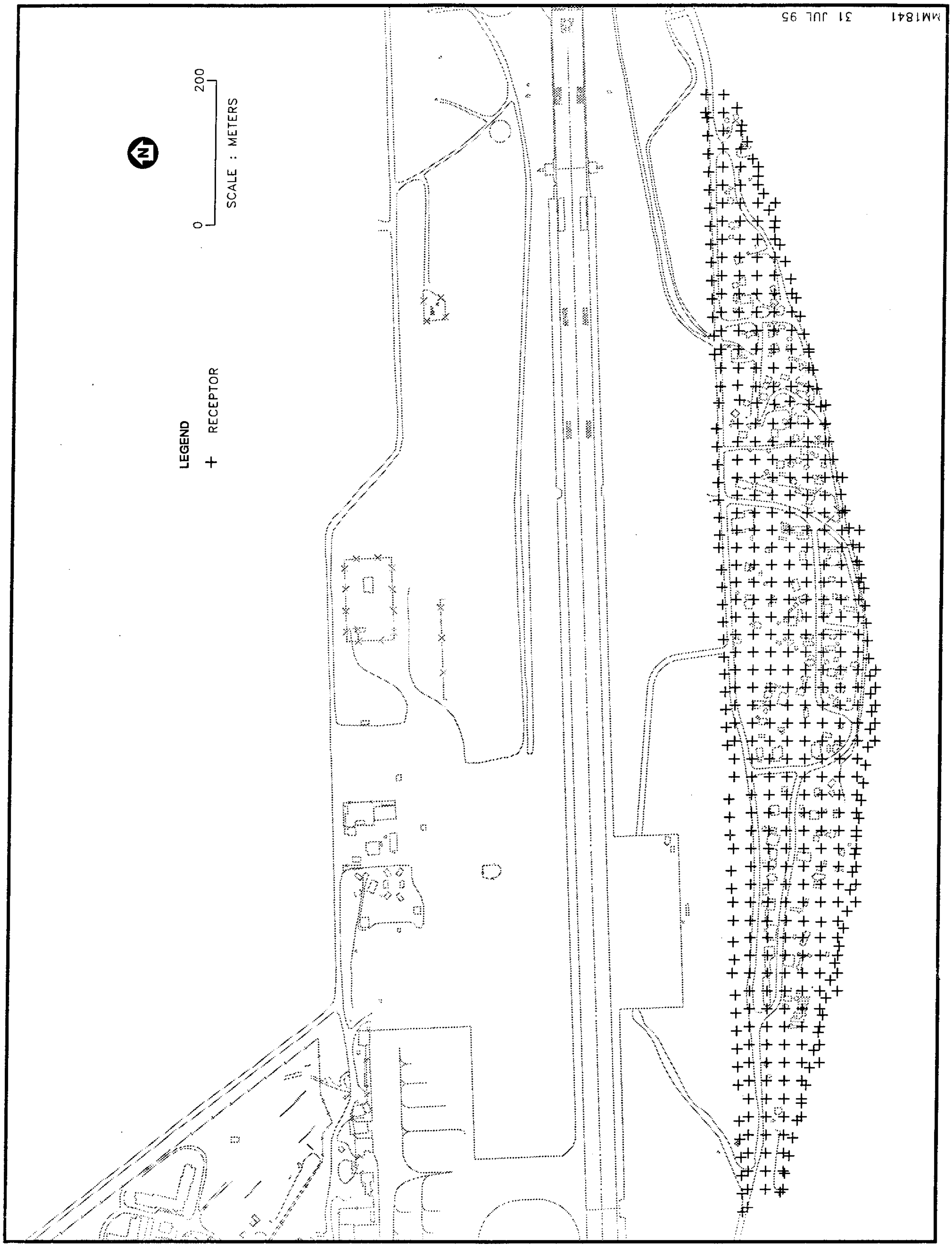

Figure D-6. Old Town Receptors

Table D-6
Maximum Predicted Concentrations for General Exposure Scenario

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m³)
Building 1700	2-Methylnaphthalene	Dormitory	2.17e-10
Building 1700	2-Methylnaphthalene	Off-Site	6.39e-11
Building 1700	2-Methylnaphthalene	New Town	2.61e-12
Building 1700	2-Methylnaphthalene	Old Town	3.05e-11
Building 1700	2-Methylnaphthalene	Residential	3.32e-10
Building 1700	Arsenic	Dormitory	3.98e-08
Building 1700	Arsenic	Off-Site	1.17e-08
Building 1700	Arsenic	New Town	4.80e-10
Building 1700	Arsenic	Old Town	5.60e-09
Building 1700	Arsenic	Residential	6.11e-08
Building 1700	Benzene	Dormitory	2.72e-02
Building 1700	Benzene	Off-Site	8.02e-03
Building 1700	Benzene	New Town	3.27e-04
Building 1700	Benzene	Old Town	3.82e-03
Building 1700	Benzene	Residential	4.17e-02
Building 1700	Lead	Dormitory	3.78e-07
Building 1700	Lead	Off-Site	1.12e-07
Building 1700	Lead	New Town	4.55e-09
Building 1700	Lead	Old Town	5.32e-08
Building 1700	Lead	Residential	5.80e-07
Fire Training Area	2-Hexanone	Dormitory	1.57e-03
Fire Training Area	2-Hexanone	Off-Site	1.45e-01
Fire Training Area	2-Hexanone	New Town	6.13e-03
Fire Training Area	2-Hexanone	Old Town	1.30e-02
Fire Training Area	2-Hexanone	Residential	1.77e-03
Fire Training Area	4,4'-DDT	Dormitory	3.44e-08
Fire Training Area	4,4'-DDT	Off-Site	3.19e-06
Fire Training Area	4,4'-DDT	New Town	1.34e-07
Fire Training Area	4,4'-DDT	Old Town	2.85e-07
Fire Training Area	4,4'-DDT	Residential	3.87e-08
Fire Training Area	Acenaphthylene	Dormitory	1.25e-08
Fire Training Area	Acenaphthylene	Off-Site	1.15e-06
Fire Training Area	Acenaphthylene	New Town	4.86e-08
Fire Training Area	Acenaphthylene	Old Town	1.03e-07
Fire Training Area	Acenaphthylene	Residential	1.40e-08
Fire Training Area	Aldrin	Dormitory	8.12e-10
Fire Training Area	Aldrin	Off-Site	7.51e-08
Fire Training Area	Aldrin	New Town	3.17e-09

Table D-6
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Fire Training Area	Aldrin	Old Town	6.72e-09
Fire Training Area	Aldrin	Residential	9.13e-10
Fire Training Area	Benzene	Dormitory	3.12e-05
Fire Training Area	Benzene	Off-Site	2.89e-03
Fire Training Area	Benzene	New Town	1.22e-04
Fire Training Area	Benzene	Old Town	2.59e-04
Fire Training Area	Benzene	Residential	3.51e-05
Fire Training Area	Benzo(a)pyrene	Dormitory	1.49e-09
Fire Training Area	Benzo(a)pyrene	Off-Site	1.38e-07
Fire Training Area	Benzo(a)pyrene	New Town	5.81e-09
Fire Training Area	Benzo(a)pyrene	Old Town	1.23e-08
Fire Training Area	Benzo(a)pyrene	Residential	1.68e-09
Fire Training Area	Benzo(g,h,i)perylene	Dormitory	4.05e-09
Fire Training Area	Benzo(g,h,i)perylene	Off-Site	3.75e-07
Fire Training Area	Benzo(g,h,i)perylene	New Town	1.58e-08
Fire Training Area	Benzo(g,h,i)perylene	Old Town	3.35e-08
Fire Training Area	Benzo(g,h,i)perylene	Residential	4.55e-09
Fire Training Area	Heptachlor epoxide	Dormitory	2.63e-10
Fire Training Area	Heptachlor epoxide	Off-Site	2.44e-08
Fire Training Area	Heptachlor epoxide	New Town	1.03e-09
Fire Training Area	Heptachlor epoxide	Old Town	2.18e-09
Fire Training Area	Heptachlor epoxide	Residential	2.96e-10
Fire Training Area	HpCDD Totals	Dormitory	8.61e-12
Fire Training Area	HpCDD Totals	Off-Site	7.97e-10
Fire Training Area	HpCDD Totals	New Town	3.36e-11
Fire Training Area	HpCDD Totals	Old Town	7.13e-11
Fire Training Area	HpCDD Totals	Residential	9.69e-12
Fire Training Area	Lead	Dormitory	5.16e-06
Fire Training Area	Lead	Off-Site	4.78e-04
Fire Training Area	Lead	New Town	2.01e-05
Fire Training Area	Lead	Old Town	4.27e-05
Fire Training Area	Lead	Residential	5.80e-06
Fire Training Area	OCDD	Dormitory	5.63e-11
Fire Training Area	OCDD	Off-Site	5.21e-09
Fire Training Area	OCDD	New Town	2.20e-10
Fire Training Area	OCDD	Old Town	4.66e-10
Fire Training Area	OCDD	Residential	6.33e-11
Fire Training Area	Phenanthrene	Dormitory	6.96e-07
Fire Training Area	Phenanthrene	Off-Site	6.44e-05

Table D-6
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Fire Training Area	Phenanthrene	New Town	2.72e-06
Fire Training Area	Phenanthrene	Old Town	5.77e-06
Fire Training Area	Phenanthrene	Residential	7.83e-07
JP-4 Fill Stands	1,1,2,2-Tetrachloroethane	Dormitory	1.36e-05
JP-4 Fill Stands	1,1,2,2-Tetrachloroethane	Off-Site	8.37e-06
JP-4 Fill Stands	1,1,2,2-Tetrachloroethane	New Town	2.89e-07
JP-4 Fill Stands	1,1,2,2-Tetrachloroethane	Old Town	5.35e-06
JP-4 Fill Stands	1,1,2,2-Tetrachloroethane	Residential	1.11e-05
JP-4 Fill Stands	2-Hexanone	Dormitory	6.13e-07
JP-4 Fill Stands	2-Hexanone	Off-Site	3.77e-07
JP-4 Fill Stands	2-Hexanone	New Town	1.30e-08
JP-4 Fill Stands	2-Hexanone	Old Town	2.41e-07
JP-4 Fill Stands	2-Hexanone	Residential	5.00e-07
JP-4 Fill Stands	2-Methylnaphthalene	Dormitory	2.71e-08
JP-4 Fill Stands	2-Methylnaphthalene	Off-Site	1.66e-08
JP-4 Fill Stands	2-Methylnaphthalene	New Town	5.75e-10
JP-4 Fill Stands	2-Methylnaphthalene	Old Town	1.06e-08
JP-4 Fill Stands	2-Methylnaphthalene	Residential	2.21e-08
JP-4 Fill Stands	4,4'-DDD	Dormitory	4.48e-08
JP-4 Fill Stands	4,4'-DDD	Off-Site	2.76e-08
JP-4 Fill Stands	4,4'-DDD	New Town	9.52e-10
JP-4 Fill Stands	4,4'-DDD	Old Town	1.76e-08
JP-4 Fill Stands	4,4'-DDD	Residential	3.66e-08
JP-4 Fill Stands	4,4'-DDE	Dormitory	2.08e-08
JP-4 Fill Stands	4,4'-DDE	Off-Site	1.28e-08
JP-4 Fill Stands	4,4'-DDE	New Town	4.43e-10
JP-4 Fill Stands	4,4'-DDE	Old Town	8.18e-09
JP-4 Fill Stands	4,4'-DDE	Residential	1.70e-08
JP-4 Fill Stands	4,4'-DDT	Dormitory	1.34e-07
JP-4 Fill Stands	4,4'-DDT	Off-Site	8.24e-08
JP-4 Fill Stands	4,4'-DDT	New Town	2.85e-09
JP-4 Fill Stands	4,4'-DDT	Old Town	5.27e-08
JP-4 Fill Stands	4,4'-DDT	Residential	1.09e-07
JP-4 Fill Stands	Acenaphthylene	Dormitory	9.42e-09
JP-4 Fill Stands	Acenaphthylene	Off-Site	5.79e-09
JP-4 Fill Stands	Acenaphthylene	New Town	2.00e-10
JP-4 Fill Stands	Acenaphthylene	Old Town	3.70e-09
JP-4 Fill Stands	Acenaphthylene	Residential	7.69e-09
JP-4 Fill Stands	Benz(a)anthracene	Dormitory	2.48e-07

Table D-6
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
JP-4 Fill Stands	Benz(a)anthracene	Off-Site	1.53e-07
JP-4 Fill Stands	Benz(a)anthracene	New Town	5.28e-09
JP-4 Fill Stands	Benz(a)anthracene	Old Town	9.76e-08
JP-4 Fill Stands	Benz(a)anthracene	Residential	2.03e-07
JP-4 Fill Stands	Benzene	Dormitory	4.50e-04
JP-4 Fill Stands	Benzene	Off-Site	2.77e-04
JP-4 Fill Stands	Benzene	New Town	9.56e-06
JP-4 Fill Stands	Benzene	Old Town	1.77e-04
JP-4 Fill Stands	Benzene	Residential	3.67e-04
JP-4 Fill Stands	Benzo(a)pyrene	Dormitory	2.02e-07
JP-4 Fill Stands	Benzo(a)pyrene	Off-Site	1.24e-07
JP-4 Fill Stands	Benzo(a)pyrene	New Town	4.29e-09
JP-4 Fill Stands	Benzo(a)pyrene	Old Town	7.93e-08
JP-4 Fill Stands	Benzo(a)pyrene	Residential	1.65e-07
JP-4 Fill Stands	Benzo(b)fluoranthene	Dormitory	2.82e-07
JP-4 Fill Stands	Benzo(b)fluoranthene	Off-Site	1.73e-07
JP-4 Fill Stands	Benzo(b)fluoranthene	New Town	5.99e-09
JP-4 Fill Stands	Benzo(b)fluoranthene	Old Town	1.11e-07
JP-4 Fill Stands	Benzo(b)fluoranthene	Residential	2.30e-07
JP-4 Fill Stands	Benzo(g,h,i)perylene	Dormitory	1.21e-07
JP-4 Fill Stands	Benzo(g,h,i)perylene	Off-Site	7.43e-08
JP-4 Fill Stands	Benzo(g,h,i)perylene	New Town	2.57e-09
JP-4 Fill Stands	Benzo(g,h,i)perylene	Old Town	4.75e-08
JP-4 Fill Stands	Benzo(g,h,i)perylene	Residential	9.86e-08
JP-4 Fill Stands	Benzo(k)fluoranthene	Dormitory	2.32e-07
JP-4 Fill Stands	Benzo(k)fluoranthene	Off-Site	1.43e-07
JP-4 Fill Stands	Benzo(k)fluoranthene	New Town	4.93e-09
JP-4 Fill Stands	Benzo(k)fluoranthene	Old Town	9.11e-08
JP-4 Fill Stands	Benzo(k)fluoranthene	Residential	1.89e-07
JP-4 Fill Stands	Chrysene	Dormitory	2.51e-07
JP-4 Fill Stands	Chrysene	Off-Site	1.55e-07
JP-4 Fill Stands	Chrysene	New Town	5.34e-09
JP-4 Fill Stands	Chrysene	Old Town	9.88e-08
JP-4 Fill Stands	Chrysene	Residential	2.05e-07
JP-4 Fill Stands	Dibenz(a,h)anthracene	Dormitory	5.62e-08
JP-4 Fill Stands	Dibenz(a,h)anthracene	Off-Site	3.45e-08
JP-4 Fill Stands	Dibenz(a,h)anthracene	New Town	1.19e-09
JP-4 Fill Stands	Dibenz(a,h)anthracene	Old Town	2.21e-08
JP-4 Fill Stands	Dibenz(a,h)anthracene	Residential	4.59e-08

Table D-6
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
JP-4 Fill Stands	Indeno(1,2,3-cd)pyrene	Dormitory	9.90e-08
JP-4 Fill Stands	Indeno(1,2,3-cd)pyrene	Off-Site	6.09e-08
JP-4 Fill Stands	Indeno(1,2,3-cd)pyrene	New Town	2.10e-09
JP-4 Fill Stands	Indeno(1,2,3-cd)pyrene	Old Town	3.89e-08
JP-4 Fill Stands	Indeno(1,2,3-cd)pyrene	Residential	8.08e-08
JP-4 Fill Stands	Lead	Dormitory	1.86e-06
JP-4 Fill Stands	Lead	Off-Site	1.14e-06
JP-4 Fill Stands	Lead	New Town	3.95e-08
JP-4 Fill Stands	Lead	Old Town	7.30e-07
JP-4 Fill Stands	Lead	Residential	1.52e-06
JP-4 Fill Stands	Pentachlorophenol	Dormitory	5.46e-08
JP-4 Fill Stands	Pentachlorophenol	Off-Site	3.35e-08
JP-4 Fill Stands	Pentachlorophenol	New Town	1.16e-09
JP-4 Fill Stands	Pentachlorophenol	Old Town	2.14e-08
JP-4 Fill Stands	Pentachlorophenol	Residential	4.46e-08
JP-4 Fill Stands	Phenanthrene	Dormitory	2.76e-07
JP-4 Fill Stands	Phenanthrene	Off-Site	1.70e-07
JP-4 Fill Stands	Phenanthrene	New Town	5.87e-09
JP-4 Fill Stands	Phenanthrene	Old Town	1.08e-07
JP-4 Fill Stands	Phenanthrene	Residential	2.25e-07
Million Gallon Hill	2-Methylnaphthalene	Dormitory	5.00e-09
Million Gallon Hill	2-Methylnaphthalene	Off-Site	3.50e-09
Million Gallon Hill	2-Methylnaphthalene	New Town	1.59e-10
Million Gallon Hill	2-Methylnaphthalene	Old Town	2.51e-09
Million Gallon Hill	2-Methylnaphthalene	Residential	5.86e-09
Million Gallon Hill	Benz(a)anthracene	Dormitory	2.36e-08
Million Gallon Hill	Benz(a)anthracene	Off-Site	1.65e-08
Million Gallon Hill	Benz(a)anthracene	New Town	7.52e-10
Million Gallon Hill	Benz(a)anthracene	Old Town	1.18e-08
Million Gallon Hill	Benz(a)anthracene	Residential	2.77e-08
Million Gallon Hill	Benzo(a)pyrene	Dormitory	5.16e-08
Million Gallon Hill	Benzo(a)pyrene	Off-Site	3.61e-08
Million Gallon Hill	Benzo(a)pyrene	New Town	1.64e-09
Million Gallon Hill	Benzo(a)pyrene	Old Town	2.58e-08
Million Gallon Hill	Benzo(a)pyrene	Residential	6.05e-08
Million Gallon Hill	Benzo(b)fluoranthene	Dormitory	1.15e-07
Million Gallon Hill	Benzo(b)fluoranthene	Off-Site	8.06e-08
Million Gallon Hill	Benzo(b)fluoranthene	New Town	3.67e-09
Million Gallon Hill	Benzo(b)fluoranthene	Old Town	5.77e-08

Table D-6
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Million Gallon Hill	Benzo(b)fluoranthene	Residential	1.35e-07
Million Gallon Hill	Benzo(g,h,i)perylene	Dormitory	3.00e-08
Million Gallon Hill	Benzo(g,h,i)perylene	Off-Site	2.10e-08
Million Gallon Hill	Benzo(g,h,i)perylene	New Town	9.57e-10
Million Gallon Hill	Benzo(g,h,i)perylene	Old Town	1.50e-08
Million Gallon Hill	Benzo(g,h,i)perylene	Residential	3.52e-08
Million Gallon Hill	Indeno(1,2,3-cd)pyrene	Dormitory	2.76e-08
Million Gallon Hill	Indeno(1,2,3-cd)pyrene	Off-Site	1.93e-08
Million Gallon Hill	Indeno(1,2,3-cd)pyrene	New Town	8.78e-10
Million Gallon Hill	Indeno(1,2,3-cd)pyrene	Old Town	1.38e-08
Million Gallon Hill	Indeno(1,2,3-cd)pyrene	Residential	3.23e-08
Million Gallon Hill	Lead	Dormitory	2.10e-04
Million Gallon Hill	Lead	Off-Site	1.47e-04
Million Gallon Hill	Lead	New Town	6.69e-06
Million Gallon Hill	Lead	Old Town	1.05e-04
Million Gallon Hill	Lead	Residential	2.46e-04
Million Gallon Hill	Phenanthrene	Dormitory	2.63e-08
Million Gallon Hill	Phenanthrene	Off-Site	1.84e-08
Million Gallon Hill	Phenanthrene	New Town	8.39e-10
Million Gallon Hill	Phenanthrene	Old Town	1.32e-08
Million Gallon Hill	Phenanthrene	Residential	3.09e-08
POL Area	2-Methylnaphthalene	Dormitory	6.30e-05
POL Area	2-Methylnaphthalene	Off-Site	8.34e-06
POL Area	2-Methylnaphthalene	New Town	8.30e-08
POL Area	2-Methylnaphthalene	Old Town	1.24e-06
POL Area	2-Methylnaphthalene	Residential	1.22e-05
POL Area	Benz(a)anthracene	Dormitory	2.51e-07
POL Area	Benz(a)anthracene	Off-Site	3.32e-08
POL Area	Benz(a)anthracene	New Town	3.30e-10
POL Area	Benz(a)anthracene	Old Town	4.95e-09
POL Area	Benz(a)anthracene	Residential	4.87e-08
POL Area	Benzene	Dormitory	1.12e+00
POL Area	Benzene	Off-Site	1.48e-01
POL Area	Benzene	New Town	1.47e-03
POL Area	Benzene	Old Town	2.21e-02
POL Area	Benzene	Residential	2.17e-01
POL Area	Benzo(a)pyrene	Dormitory	1.69e-07
POL Area	Benzo(a)pyrene	Off-Site	2.23e-08
POL Area	Benzo(a)pyrene	New Town	2.22e-10

Table D-6
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
POL Area	Benzo(a)pyrene	Old Town	3.33e-09
POL Area	Benzo(a)pyrene	Residential	3.28e-08
POL Area	Benzo(b)fluoranthene	Dormitory	2.10e-07
POL Area	Benzo(b)fluoranthene	Off-Site	2.78e-08
POL Area	Benzo(b)fluoranthene	New Town	2.76e-10
POL Area	Benzo(b)fluoranthene	Old Town	4.14e-09
POL Area	Benzo(b)fluoranthene	Residential	4.07e-08
POL Area	Benzo(g,h,i)perylene	Dormitory	1.81e-07
POL Area	Benzo(g,h,i)perylene	Off-Site	2.39e-08
POL Area	Benzo(g,h,i)perylene	New Town	2.38e-10
POL Area	Benzo(g,h,i)perylene	Old Town	3.57e-09
POL Area	Benzo(g,h,i)perylene	Residential	3.51e-08
POL Area	Dibenz(a,h)anthracene	Dormitory	8.72e-08
POL Area	Dibenz(a,h)anthracene	Off-Site	1.15e-08
POL Area	Dibenz(a,h)anthracene	New Town	1.15e-10
POL Area	Dibenz(a,h)anthracene	Old Town	1.72e-09
POL Area	Dibenz(a,h)anthracene	Residential	1.69e-08
POL Area	Dieldrin	Dormitory	6.21e-08
POL Area	Dieldrin	Off-Site	8.21e-09
POL Area	Dieldrin	New Town	8.17e-11
POL Area	Dieldrin	Old Town	1.22e-09
POL Area	Dieldrin	Residential	1.20e-08
POL Area	Lead	Dormitory	4.54e-04
POL Area	Lead	Off-Site	6.01e-05
POL Area	Lead	New Town	5.98e-07
POL Area	Lead	Old Town	8.96e-06
POL Area	Lead	Residential	8.81e-05
POL Area	Phenanthrene	Dormitory	1.71e-06
POL Area	Phenanthrene	Off-Site	2.25e-07
POL Area	Phenanthrene	New Town	2.24e-09
POL Area	Phenanthrene	Old Town	3.36e-08
POL Area	Phenanthrene	Residential	3.31e-07
Power Plant	2-Hexanone	Dormitory	9.73e-04
Power Plant	2-Hexanone	Off-Site	3.08e-04
Power Plant	2-Hexanone	New Town	1.62e-05
Power Plant	2-Hexanone	Old Town	2.18e-04
Power Plant	2-Hexanone	Residential	1.17e-03
Power Plant	2-Methylnaphthalene	Dormitory	4.25e-08
Power Plant	2-Methylnaphthalene	Off-Site	1.35e-08

Table D-6
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Power Plant	2-Methylnaphthalene	New Town	7.10e-10
Power Plant	2-Methylnaphthalene	Old Town	9.54e-09
Power Plant	2-Methylnaphthalene	Residential	5.09e-08
Power Plant	Aluminum	Dormitory	1.95e-05
Power Plant	Aluminum	Off-Site	6.17e-06
Power Plant	Aluminum	New Town	3.26e-07
Power Plant	Aluminum	Old Town	4.37e-06
Power Plant	Aluminum	Residential	2.33e-05
Power Plant	Beryllium	Dormitory	4.96e-10
Power Plant	Beryllium	Off-Site	1.57e-10
Power Plant	Beryllium	New Town	8.29e-12
Power Plant	Beryllium	Old Town	1.11e-10
Power Plant	Beryllium	Residential	5.94e-10
Power Plant	Dieldrin	Dormitory	1.56e-11
Power Plant	Dieldrin	Off-Site	4.94e-12
Power Plant	Dieldrin	New Town	2.60e-13
Power Plant	Dieldrin	Old Town	3.50e-12
Power Plant	Dieldrin	Residential	1.87e-11
Power Plant	Lead	Dormitory	7.66e-08
Power Plant	Lead	Off-Site	2.42e-08
Power Plant	Lead	New Town	1.28e-09
Power Plant	Lead	Old Town	1.72e-08
Power Plant	Lead	Residential	9.17e-08
Power Plant	Manganese (food)	Dormitory	7.80e-07
Power Plant	Manganese (food)	Off-Site	2.47e-07
Power Plant	Manganese (food)	New Town	1.30e-08
Power Plant	Manganese (food)	Old Town	1.75e-07
Power Plant	Manganese (food)	Residential	9.34e-07
Power Plant	alpha-BHC	Dormitory	2.84e-11
Power Plant	alpha-BHC	Off-Site	8.97e-12
Power Plant	alpha-BHC	New Town	4.73e-13
Power Plant	alpha-BHC	Old Town	6.36e-12
Power Plant	alpha-BHC	Residential	3.40e-11
Waste Accumulation Area	2-Methylnaphthalene	Dormitory	6.60e-10
Waste Accumulation Area	2-Methylnaphthalene	Off-Site	2.19e-10
Waste Accumulation Area	2-Methylnaphthalene	New Town	1.15e-11
Waste Accumulation Area	2-Methylnaphthalene	Old Town	1.65e-10
Waste Accumulation Area	2-Methylnaphthalene	Residential	6.62e-10
Waste Accumulation Area	4,4'-DDD	Dormitory	1.87e-07

Table D-6
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Waste Accumulation Area	4,4'-DDD	Off-Site	6.21e-08
Waste Accumulation Area	4,4'-DDD	New Town	3.25e-09
Waste Accumulation Area	4,4'-DDD	Old Town	4.68e-08
Waste Accumulation Area	4,4'-DDD	Residential	1.88e-07
Waste Accumulation Area	4,4'-DDE	Dormitory	1.42e-08
Waste Accumulation Area	4,4'-DDE	Off-Site	4.70e-09
Waste Accumulation Area	4,4'-DDE	New Town	2.46e-10
Waste Accumulation Area	4,4'-DDE	Old Town	3.55e-09
Waste Accumulation Area	4,4'-DDE	Residential	1.42e-08
Waste Accumulation Area	4,4'-DDT	Dormitory	2.50e-07
Waste Accumulation Area	4,4'-DDT	Off-Site	8.31e-08
Waste Accumulation Area	4,4'-DDT	New Town	4.35e-09
Waste Accumulation Area	4,4'-DDT	Old Town	6.27e-08
Waste Accumulation Area	4,4'-DDT	Residential	2.51e-07
Waste Accumulation Area	Aldrin	Dormitory	3.61e-10
Waste Accumulation Area	Aldrin	Off-Site	1.20e-10
Waste Accumulation Area	Aldrin	New Town	6.27e-12
Waste Accumulation Area	Aldrin	Old Town	9.04e-11
Waste Accumulation Area	Aldrin	Residential	3.62e-10
Waste Accumulation Area	Benz(a)anthracene	Dormitory	1.90e-08
Waste Accumulation Area	Benz(a)anthracene	Off-Site	6.31e-09
Waste Accumulation Area	Benz(a)anthracene	New Town	3.30e-10
Waste Accumulation Area	Benz(a)anthracene	Old Town	4.76e-09
Waste Accumulation Area	Benz(a)anthracene	Residential	1.91e-08
Waste Accumulation Area	Benzo(a)pyrene	Dormitory	1.52e-08
Waste Accumulation Area	Benzo(a)pyrene	Off-Site	5.05e-09
Waste Accumulation Area	Benzo(a)pyrene	New Town	2.64e-10
Waste Accumulation Area	Benzo(a)pyrene	Old Town	3.81e-09
Waste Accumulation Area	Benzo(a)pyrene	Residential	1.53e-08
Waste Accumulation Area	Benzo(b)fluoranthene	Dormitory	1.62e-08
Waste Accumulation Area	Benzo(b)fluoranthene	Off-Site	5.39e-09
Waste Accumulation Area	Benzo(b)fluoranthene	New Town	2.82e-10
Waste Accumulation Area	Benzo(b)fluoranthene	Old Town	4.06e-09
Waste Accumulation Area	Benzo(b)fluoranthene	Residential	1.63e-08
Waste Accumulation Area	Benzo(g,h,i)perylene	Dormitory	7.87e-09
Waste Accumulation Area	Benzo(g,h,i)perylene	Off-Site	2.61e-09
Waste Accumulation Area	Benzo(g,h,i)perylene	New Town	1.37e-10
Waste Accumulation Area	Benzo(g,h,i)perylene	Old Town	1.97e-09
Waste Accumulation Area	Benzo(g,h,i)perylene	Residential	7.90e-09

Table D-6
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Waste Accumulation Area	Dibenz(a,h)anthracene	Dormitory	5.06e-09
Waste Accumulation Area	Dibenz(a,h)anthracene	Off-Site	1.68e-09
Waste Accumulation Area	Dibenz(a,h)anthracene	New Town	8.79e-11
Waste Accumulation Area	Dibenz(a,h)anthracene	Old Town	1.27e-09
Waste Accumulation Area	Dibenz(a,h)anthracene	Residential	5.08e-09
Waste Accumulation Area	Dieldrin	Dormitory	8.71e-09
Waste Accumulation Area	Dieldrin	Off-Site	2.89e-09
Waste Accumulation Area	Dieldrin	New Town	1.51e-10
Waste Accumulation Area	Dieldrin	Old Town	2.18e-09
Waste Accumulation Area	Dieldrin	Residential	8.74e-09
Waste Accumulation Area	Heptachlor epoxide	Dormitory	5.68e-11
Waste Accumulation Area	Heptachlor epoxide	Off-Site	1.89e-11
Waste Accumulation Area	Heptachlor epoxide	New Town	9.86e-13
Waste Accumulation Area	Heptachlor epoxide	Old Town	1.42e-11
Waste Accumulation Area	Heptachlor epoxide	Residential	5.70e-11
Waste Accumulation Area	Indeno(1,2,3-cd)pyrene	Dormitory	7.12e-09
Waste Accumulation Area	Indeno(1,2,3-cd)pyrene	Off-Site	2.36e-09
Waste Accumulation Area	Indeno(1,2,3-cd)pyrene	New Town	1.24e-10
Waste Accumulation Area	Indeno(1,2,3-cd)pyrene	Old Town	1.78e-09
Waste Accumulation Area	Indeno(1,2,3-cd)pyrene	Residential	7.15e-09
Waste Accumulation Area	Lead	Dormitory	7.48e-06
Waste Accumulation Area	Lead	Off-Site	2.48e-06
Waste Accumulation Area	Lead	New Town	1.30e-07
Waste Accumulation Area	Lead	Old Town	1.87e-06
Waste Accumulation Area	Lead	Residential	7.50e-06
Waste Accumulation Area	Phenanthrene	Dormitory	2.65e-08
Waste Accumulation Area	Phenanthrene	Off-Site	8.79e-09
Waste Accumulation Area	Phenanthrene	New Town	4.60e-10
Waste Accumulation Area	Phenanthrene	Old Town	6.63e-09
Waste Accumulation Area	Phenanthrene	Residential	2.66e-08
Waste Accumulation Area	gamma-BHC	Dormitory	3.37e-10
Waste Accumulation Area	gamma-BHC	Off-Site	1.12e-10
Waste Accumulation Area	gamma-BHC	New Town	5.86e-12
Waste Accumulation Area	gamma-BHC	Old Town	8.45e-11
Waste Accumulation Area	gamma-BHC	Residential	3.39e-10
West Unit	1,1,2,2-Tetrachloroethane	Dormitory	1.36e-05
West Unit	1,1,2,2-Tetrachloroethane	Off-Site	8.37e-06
West Unit	1,1,2,2-Tetrachloroethane	New Town	2.89e-07
West Unit	1,1,2,2-Tetrachloroethane	Old Town	5.35e-06

Table D-6
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
West Unit	1,1,2,2-Tetrachloroethane	Residential	1.11e-05
West Unit	2-Hexanone	Dormitory	9.73e-04
West Unit	2-Hexanone	Off-Site	3.08e-04
West Unit	2-Hexanone	New Town	1.62e-05
West Unit	2-Hexanone	Old Town	2.18e-04
West Unit	2-Hexanone	Residential	1.17e-03
West Unit	2-Methylnaphthalene	Dormitory	4.25e-08
West Unit	2-Methylnaphthalene	Off-Site	1.66e-08
West Unit	2-Methylnaphthalene	New Town	7.10e-10
West Unit	2-Methylnaphthalene	Old Town	1.06e-08
West Unit	2-Methylnaphthalene	Residential	5.09e-08
West Unit	4,4'-DDD	Dormitory	1.87e-07
West Unit	4,4'-DDD	Off-Site	6.21e-08
West Unit	4,4'-DDD	New Town	3.25e-09
West Unit	4,4'-DDD	Old Town	4.68e-08
West Unit	4,4'-DDD	Residential	1.88e-07
West Unit	4,4'-DDE	Dormitory	2.08e-08
West Unit	4,4'-DDE	Off-Site	1.28e-08
West Unit	4,4'-DDE	New Town	4.43e-10
West Unit	4,4'-DDE	Old Town	8.18e-09
West Unit	4,4'-DDE	Residential	1.70e-08
West Unit	4,4'-DDT	Dormitory	2.50e-07
West Unit	4,4'-DDT	Off-Site	8.31e-08
West Unit	4,4'-DDT	New Town	4.35e-09
West Unit	4,4'-DDT	Old Town	6.27e-08
West Unit	4,4'-DDT	Residential	2.51e-07
West Unit	Acenaphthylene	Dormitory	9.42e-09
West Unit	Acenaphthylene	Off-Site	5.79e-09
West Unit	Acenaphthylene	New Town	2.00e-10
West Unit	Acenaphthylene	Old Town	3.70e-09
West Unit	Acenaphthylene	Residential	7.69e-09
West Unit	Aldrin	Dormitory	3.61e-10
West Unit	Aldrin	Off-Site	1.20e-10
West Unit	Aldrin	New Town	6.27e-12
West Unit	Aldrin	Old Town	9.04e-11
West Unit	Aldrin	Residential	3.62e-10
West Unit	Aluminum	Dormitory	1.95e-05
West Unit	Aluminum	Off-Site	6.17e-06
West Unit	Aluminum	New Town	3.26e-07

**Table D-6
(Continued)**

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
West Unit	Aluminum	Old Town	4.37e-06
West Unit	Aluminum	Residential	2.33e-05
West Unit	Arsenic	Dormitory	3.98e-08
West Unit	Arsenic	Off-Site	1.17e-08
West Unit	Arsenic	New Town	4.80e-10
West Unit	Arsenic	Old Town	5.60e-09
West Unit	Arsenic	Residential	6.11e-08
West Unit	Benz(a)anthracene	Dormitory	2.48e-07
West Unit	Benz(a)anthracene	Off-Site	1.53e-07
West Unit	Benz(a)anthracene	New Town	5.28e-09
West Unit	Benz(a)anthracene	Old Town	9.76e-08
West Unit	Benz(a)anthracene	Residential	2.03e-07
West Unit	Benzene	Dormitory	2.72e-02
West Unit	Benzene	Off-Site	8.02e-03
West Unit	Benzene	New Town	3.27e-04
West Unit	Benzene	Old Town	3.82e-03
West Unit	Benzene	Residential	4.17e-02
West Unit	Benzo(a)pyrene	Dormitory	2.02e-07
West Unit	Benzo(a)pyrene	Off-Site	1.24e-07
West Unit	Benzo(a)pyrene	New Town	4.29e-09
West Unit	Benzo(a)pyrene	Old Town	7.93e-08
West Unit	Benzo(a)pyrene	Residential	1.65e-07
West Unit	Benzo(b)fluoranthene	Dormitory	2.82e-07
West Unit	Benzo(b)fluoranthene	Off-Site	1.73e-07
West Unit	Benzo(b)fluoranthene	New Town	5.99e-09
West Unit	Benzo(b)fluoranthene	Old Town	1.11e-07
West Unit	Benzo(b)fluoranthene	Residential	2.30e-07
West Unit	Benzo(g,h,i)perylene	Dormitory	1.21e-07
West Unit	Benzo(g,h,i)perylene	Off-Site	7.43e-08
West Unit	Benzo(g,h,i)perylene	New Town	2.57e-09
West Unit	Benzo(g,h,i)perylene	Old Town	4.75e-08
West Unit	Benzo(g,h,i)perylene	Residential	9.86e-08
West Unit	Benzo(k)fluoranthene	Dormitory	2.32e-07
West Unit	Benzo(k)fluoranthene	Off-Site	1.43e-07
West Unit	Benzo(k)fluoranthene	New Town	4.93e-09
West Unit	Benzo(k)fluoranthene	Old Town	9.11e-08
West Unit	Benzo(k)fluoranthene	Residential	1.89e-07
West Unit	Beryllium	Dormitory	4.96e-10
West Unit	Beryllium	Off-Site	1.57e-10

Table D-6
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
West Unit	Beryllium	New Town	8.29e-12
West Unit	Beryllium	Old Town	1.11e-10
West Unit	Beryllium	Residential	5.94e-10
West Unit	Chrysene	Dormitory	2.51e-07
West Unit	Chrysene	Off-Site	1.55e-07
West Unit	Chrysene	New Town	5.34e-09
West Unit	Chrysene	Old Town	9.88e-08
West Unit	Chrysene	Residential	2.05e-07
West Unit	Dibenz(a,h)anthracene	Dormitory	5.62e-08
West Unit	Dibenz(a,h)anthracene	Off-Site	3.45e-08
West Unit	Dibenz(a,h)anthracene	New Town	1.19e-09
West Unit	Dibenz(a,h)anthracene	Old Town	2.21e-08
West Unit	Dibenz(a,h)anthracene	Residential	4.59e-08
West Unit	Dieldrin	Dormitory	8.71e-09
West Unit	Dieldrin	Off-Site	2.89e-09
West Unit	Dieldrin	New Town	1.51e-10
West Unit	Dieldrin	Old Town	2.18e-09
West Unit	Dieldrin	Residential	8.74e-09
West Unit	Heptachlor epoxide	Dormitory	5.68e-11
West Unit	Heptachlor epoxide	Off-Site	1.89e-11
West Unit	Heptachlor epoxide	New Town	9.86e-13
West Unit	Heptachlor epoxide	Old Town	1.42e-11
West Unit	Heptachlor epoxide	Residential	5.70e-11
West Unit	HpCDD Totals	Dormitory	0.00e+00
West Unit	HpCDD Totals	Off-Site	0.00e+00
West Unit	HpCDD Totals	New Town	0.00e+00
West Unit	HpCDD Totals	Old Town	0.00e+00
West Unit	HpCDD Totals	Residential	0.00e+00
West Unit	Indeno(1,2,3-cd)pyrene	Dormitory	9.90e-08
West Unit	Indeno(1,2,3-cd)pyrene	Off-Site	6.09e-08
West Unit	Indeno(1,2,3-cd)pyrene	New Town	2.10e-09
West Unit	Indeno(1,2,3-cd)pyrene	Old Town	3.89e-08
West Unit	Indeno(1,2,3-cd)pyrene	Residential	8.08e-08
West Unit	Lead	Dormitory	2.10e-04
West Unit	Lead	Off-Site	1.47e-04
West Unit	Lead	New Town	6.69e-06
West Unit	Lead	Old Town	1.05e-04
West Unit	Lead	Residential	2.46e-04
West Unit	Manganese (food)	Dormitory	7.80e-07

**Table D-6
(Continued)**

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
West Unit	Manganese (food)	Off-Site	2.47e-07
West Unit	Manganese (food)	New Town	1.30e-08
West Unit	Manganese (food)	Old Town	1.75e-07
West Unit	Manganese (food)	Residential	9.34e-07
West Unit	OCDD	Dormitory	0.00e+00
West Unit	OCDD	Off-Site	0.00e+00
West Unit	OCDD	New Town	0.00e+00
West Unit	OCDD	Old Town	0.00e+00
West Unit	OCDD	Residential	0.00e+00
West Unit	Pentachlorophenol	Dormitory	5.46e-08
West Unit	Pentachlorophenol	Off-Site	3.35e-08
West Unit	Pentachlorophenol	New Town	1.16e-09
West Unit	Pentachlorophenol	Old Town	2.14e-08
West Unit	Pentachlorophenol	Residential	4.46e-08
West Unit	Phenanthrene	Dormitory	2.76e-07
West Unit	Phenanthrene	Off-Site	1.70e-07
West Unit	Phenanthrene	New Town	5.87e-09
West Unit	Phenanthrene	Old Town	1.08e-07
West Unit	Phenanthrene	Residential	2.25e-07
West Unit	alpha-BHC	Dormitory	2.84e-11
West Unit	alpha-BHC	Off-Site	8.97e-12
West Unit	alpha-BHC	New Town	4.73e-13
West Unit	alpha-BHC	Old Town	6.36e-12
West Unit	alpha-BHC	Residential	3.40e-11
West Unit	gamma-BHC	Dormitory	3.37e-10
West Unit	gamma-BHC	Off-Site	1.12e-10
West Unit	gamma-BHC	New Town	5.86e-12
West Unit	gamma-BHC	Old Town	8.45e-11
West Unit	gamma-BHC	Residential	3.39e-10

Table D-7
Maximum Predicted Concentrations for On-Site Worker Exposures

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Building 1700	2-Methylnaphthalene	Worker	3.46e-07
Building 1700	Arsenic	Worker	6.36e-05
Building 1700	Benzene	Worker	4.34e+01
Building 1700	Lead	Worker	6.04e-04
Fire Training Area	2-Hexanone	Worker	1.47e+01
Fire Training Area	4,4'-DDT	Worker	3.23e-04
Fire Training Area	Acenaphthylene	Worker	1.17e-04
Fire Training Area	Aldrin	Worker	7.61e-06
Fire Training Area	Benzene	Worker	2.93e-01
Fire Training Area	Benzo(a)pyrene	Worker	1.40e-05
Fire Training Area	Benzo(g,h,i)perylene	Worker	3.79e-05
Fire Training Area	Heptachlor epoxide	Worker	2.47e-06
Fire Training Area	HpCDD Totals	Worker	8.07e-08
Fire Training Area	Lead	Worker	4.84e-02
Fire Training Area	OCDD	Worker	5.27e-07
Fire Training Area	Phenanthrene	Worker	6.52e-03
JP-4 Fill Stands	1,1,2,2-Tetrachloroethane	Worker	3.65e-03
JP-4 Fill Stands	2-Hexanone	Worker	1.64e-04
JP-4 Fill Stands	2-Methylnaphthalene	Worker	7.24e-06
JP-4 Fill Stands	4,4'-DDD	Worker	1.20e-05
JP-4 Fill Stands	4,4'-DDE	Worker	5.58e-06
JP-4 Fill Stands	4,4'-DDT	Worker	3.59e-05
JP-4 Fill Stands	Acenaphthylene	Worker	2.52e-06
JP-4 Fill Stands	Benz(a)anthracene	Worker	6.65e-05
JP-4 Fill Stands	Benzene	Worker	1.20e-01
JP-4 Fill Stands	Benzo(a)pyrene	Worker	5.40e-05
JP-4 Fill Stands	Benzo(b)fluoranthene	Worker	7.55e-05
JP-4 Fill Stands	Benzo(g,h,i)perylene	Worker	3.23e-05
JP-4 Fill Stands	Benzo(k)fluoranthene	Worker	6.21e-05
JP-4 Fill Stands	Chrysene	Worker	6.73e-05
JP-4 Fill Stands	Dibenz(a,h)anthracene	Worker	1.50e-05
JP-4 Fill Stands	Indeno(1,2,3-cd)pyrene	Worker	2.65e-05
JP-4 Fill Stands	Lead	Worker	4.98e-04
JP-4 Fill Stands	Pentachlorophenol	Worker	1.46e-05
JP-4 Fill Stands	Phenanthrene	Worker	7.39e-05
Million Gallon Hill	2-Methylnaphthalene	Worker	5.96e-07
Million Gallon Hill	Benz(a)anthracene	Worker	2.81e-06
Million Gallon Hill	Benzo(a)pyrene	Worker	6.15e-06

Table D-7
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Million Gallon Hill	Benzo(b)fluoranthene	Worker	1.37e-05
Million Gallon Hill	Benzo(g,h,i)perylene	Worker	3.58e-06
Million Gallon Hill	Indeno(1,2,3-cd)pyrene	Worker	3.28e-06
Million Gallon Hill	Lead	Worker	2.50e-02
Million Gallon Hill	Phenanthrene	Worker	3.14e-06
POL Area	2-Methylnaphthalene	Worker	2.38e-04
POL Area	Benz(a)anthracene	Worker	9.46e-07
POL Area	Benzene	Worker	4.22e+00
POL Area	Benzo(a)pyrene	Worker	6.37e-07
POL Area	Benzo(b)fluoranthene	Worker	7.92e-07
POL Area	Benzo(g,h,i)perylene	Worker	6.82e-07
POL Area	Dibenz(a,h)anthracene	Worker	3.29e-07
POL Area	Dieldrin	Worker	2.34e-07
POL Area	Lead	Worker	1.71e-03
POL Area	Phenanthrene	Worker	6.43e-06
Power Plant	2-Hexanone	Worker	3.53e+00
Power Plant	2-Methylnaphthalene	Worker	1.54e-04
Power Plant	alpha-BHC	Worker	1.03e-07
Power Plant	Aluminum	Worker	7.08e-02
Power Plant	Beryllium	Worker	1.80e-06
Power Plant	Dieldrin	Worker	5.66e-08
Power Plant	Lead	Worker	2.78e-04
Power Plant	Manganese (food)	Worker	2.83e-03
Waste Accumulation Area	2-Methylnaphthalene	Worker	2.17e-07
Waste Accumulation Area	4,4'-DDD	Worker	6.17e-05
Waste Accumulation Area	4,4'-DDE	Worker	4.67e-06
Waste Accumulation Area	4,4'-DDT	Worker	8.25e-05
Waste Accumulation Area	Aldrin	Worker	1.19e-07
Waste Accumulation Area	Benz(a)anthracene	Worker	6.27e-06
Waste Accumulation Area	Benzo(a)pyrene	Worker	5.01e-06
Waste Accumulation Area	Benzo(b)fluoranthene	Worker	5.35e-06
Waste Accumulation Area	Benzo(g,h,i)perylene	Worker	2.59e-06
Waste Accumulation Area	Dibenz(a,h)anthracene	Worker	1.67e-06
Waste Accumulation Area	Dieldrin	Worker	2.87e-06
Waste Accumulation Area	gamma-BHC	Worker	1.11e-07
Waste Accumulation Area	Heptachlor epoxide	Worker	1.87e-08
Waste Accumulation Area	Indeno(1,2,3-cd)pyrene	Worker	2.35e-06
Waste Accumulation Area	Lead	Worker	2.46e-03
Waste Accumulation Area	Phenanthrene	Worker	8.73e-06

Table D-8
Maximum Predicted Concentrations for Six-Month Construction Worker Exposures

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Building 1700	2-Methylnaphthalene	Worker	3.73e-02
Building 1700	Arsenic	Worker	5.42e-03
Building 1700	Benzene	Worker	1.92e+02
Building 1700	bis(2-Ethylhexyl)phthalat	Worker	1.51e-02
Building 1700	Lead	Worker	5.06e-02
Building 1700	Phenanthrene	Worker	4.84e-04
Building 1845	2-Methylnaphthalene	Worker	1.05e-04
Building 1845	4,4'-DDD	Worker	9.56e-03
Building 1845	4,4'-DDT	Worker	3.54e-03
Building 1845	Aluminum	Worker	9.37e+00
Building 1845	Arsenic	Worker	8.89e-03
Building 1845	Beryllium	Worker	2.49e-04
Building 1845	Lead	Worker	7.75e-03
Building 1845	Manganese (food)	Worker	4.59e-01
Fire Training Area	2-Hexanone	Worker	8.38e+00
Fire Training Area	4,4'-DDT	Worker	7.14e-04
Fire Training Area	Acenaphthylene	Worker	2.58e-04
Fire Training Area	Aldrin	Worker	1.68e-05
Fire Training Area	Benz(a)anthracene	Worker	7.90e-04
Fire Training Area	Benzene	Worker	1.29e+02
Fire Training Area	Benzo(a)pyrene	Worker	5.34e-04
Fire Training Area	Benzo(b)fluoranthene	Worker	3.39e-04
Fire Training Area	Benzo(g,h,i)perylene	Worker	1.66e-04
Fire Training Area	Dibenz(a,h)anthracene	Worker	2.85e-05
Fire Training Area	Heptachlor epoxide	Worker	5.45e-06
Fire Training Area	HpCDD Totals	Worker	1.78e-07
Fire Training Area	Lead	Worker	1.07e-01
Fire Training Area	OCDD	Worker	1.17e-06
Fire Training Area	Phenanthrene	Worker	1.44e-02
JP-4 Fill Stands	1,1,2,2-Tetrachloroethane	Worker	1.90e+00
JP-4 Fill Stands	2-Hexanone	Worker	2.48e-01
JP-4 Fill Stands	2-Methylnaphthalene	Worker	3.47e-02
JP-4 Fill Stands	4,4'-DDD	Worker	1.05e-03
JP-4 Fill Stands	4,4'-DDE	Worker	4.90e-04
JP-4 Fill Stands	4,4'-DDT	Worker	3.15e-03
JP-4 Fill Stands	Acenaphthylene	Worker	2.22e-04
JP-4 Fill Stands	Benz(a)anthracene	Worker	5.84e-03
JP-4 Fill Stands	Benzene	Worker	8.53e+01
JP-4 Fill Stands	Benzo(a)pyrene	Worker	4.75e-03

Table D-8
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
JP-4 Fill Stands	Benzo(b)fluoranthene	Worker	6.63e-03
JP-4 Fill Stands	Benzo(g,h,i)perylene	Worker	2.84e-03
JP-4 Fill Stands	Benzo(k)fluoranthene	Worker	5.45e-03
JP-4 Fill Stands	Chrysene	Worker	5.91e-03
JP-4 Fill Stands	Dibenz(a,h)anthracene	Worker	1.32e-03
JP-4 Fill Stands	Indeno(1,2,3-cd)pyrene	Worker	2.33e-03
JP-4 Fill Stands	Lead	Worker	4.37e-02
JP-4 Fill Stands	Pentachlorophenol	Worker	1.28e-03
JP-4 Fill Stands	Phenanthrene	Worker	6.49e-03
Million Gallon Hill	2-Methylnaphthalene	Worker	1.59e-04
Million Gallon Hill	Acenaphthylene	Worker	1.32e-05
Million Gallon Hill	Benz(a)anthracene	Worker	2.37e-04
Million Gallon Hill	Benzo(a)pyrene	Worker	5.17e-04
Million Gallon Hill	Benzo(b)fluoranthene	Worker	1.16e-03
Million Gallon Hill	Benzo(g,h,i)perylene	Worker	3.01e-04
Million Gallon Hill	Dibenz(a,h)anthracene	Worker	6.87e-05
Million Gallon Hill	Indeno(1,2,3-cd)pyrene	Worker	2.77e-04
Million Gallon Hill	Lead	Worker	2.11e+00
Million Gallon Hill	Phenanthrene	Worker	2.64e-04
POL Area	2-Methylnaphthalene	Worker	5.31e-02
POL Area	Benz(a)anthracene	Worker	7.64e-05
POL Area	Benzene	Worker	2.82e+03
POL Area	Benzo(a)pyrene	Worker	5.15e-05
POL Area	Benzo(b)fluoranthene	Worker	6.40e-05
POL Area	Benzo(g,h,i)perylene	Worker	5.51e-05
POL Area	Dibenz(a,h)anthracene	Worker	2.66e-05
POL Area	Dieldrin	Worker	1.89e-05
POL Area	Lead	Worker	1.38e-01
POL Area	Phenanthrene	Worker	5.19e-04
Power Plant	2-Hexanone	Worker	1.92e+00
Power Plant	2-Methylnaphthalene	Worker	1.27e-02
Power Plant	alpha-BHC	Worker	8.45e-06
Power Plant	Aluminum	Worker	5.81e+00
Power Plant	Arsenic	Worker	5.28e-03
Power Plant	Beryllium	Worker	1.64e-04
Power Plant	Dieldrin	Worker	6.33e-06
Power Plant	gamma-BHC	Worker	2.64e-05
Power Plant	Heptachlor epoxide	Worker	6.33e-06
Power Plant	Lead	Worker	2.28e-02

Table D-8
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Power Plant	Manganese (food)	Worker	2.32e-01
Waste Accumulation Area	2-Methylnaphthalene	Worker	4.05e-05
Waste Accumulation Area	4,4'-DDD	Worker	5.36e-03
Waste Accumulation Area	4,4'-DDE	Worker	4.06e-04
Waste Accumulation Area	4,4'-DDT	Worker	7.17e-03
Waste Accumulation Area	Aldrin	Worker	1.03e-05
Waste Accumulation Area	Benz(a)anthracene	Worker	5.44e-04
Waste Accumulation Area	Benzo(a)pyrene	Worker	4.35e-04
Waste Accumulation Area	Benzo(b)fluoranthene	Worker	4.65e-04
Waste Accumulation Area	Benzo(g,h,i)perylene	Worker	2.25e-04
Waste Accumulation Area	Dibenz(a,h)anthracene	Worker	1.45e-04
Waste Accumulation Area	Dieldrin	Worker	2.49e-04
Waste Accumulation Area	gamma-BHC	Worker	9.66e-06
Waste Accumulation Area	Heptachlor epoxide	Worker	1.63e-06
Waste Accumulation Area	Indeno(1,2,3-cd)pyrene	Worker	2.04e-04
Waste Accumulation Area	Lead	Worker	2.14e-01
Waste Accumulation Area	Phenanthrene	Worker	7.58e-04

Table D-9
Maximum Predicted Concentrations for Three-Month Construction Worker Exposures

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Building 1700	2-Methylnaphthalene	Worker	3.64e-02
Building 1700	Arsenic	Worker	5.28e-03
Building 1700	Benzene	Worker	1.87e+02
Building 1700	bis(2-Ethylhexyl)phthalat	Worker	1.47e-02
Building 1700	Lead	Worker	4.93e-02
Building 1700	Phenanthrene	Worker	4.72e-04
Building 1845	2-Methylnaphthalene	Worker	1.02e-04
Building 1845	4,4'-DDD	Worker	9.30e-03
Building 1845	4,4'-DDT	Worker	3.44e-03
Building 1845	Aluminum	Worker	9.11e+00
Building 1845	Arsenic	Worker	8.65e-03
Building 1845	Beryllium	Worker	2.42e-04
Building 1845	Lead	Worker	7.53e-03
Building 1845	Manganese (food)	Worker	4.46e-01
Fire Training Area	2-Hexanone	Worker	8.16e+00
Fire Training Area	4,4'-DDT	Worker	6.95e-04
Fire Training Area	Acenaphthylene	Worker	2.52e-04
Fire Training Area	Aldrin	Worker	1.64e-05
Fire Training Area	Benz(a)anthracene	Worker	7.69e-04
Fire Training Area	Benzene	Worker	1.26e+02
Fire Training Area	Benzo(a)pyrene	Worker	5.20e-04
Fire Training Area	Benzo(b)fluoranthene	Worker	3.30e-04
Fire Training Area	Benzo(g,h,i)perylene	Worker	1.62e-04
Fire Training Area	Dibenz(a,h)anthracene	Worker	2.78e-05
Fire Training Area	Heptachlor epoxide	Worker	5.31e-06
Fire Training Area	HpCDD Totals	Worker	1.74e-07
Fire Training Area	Lead	Worker	1.04e-01
Fire Training Area	OCDD	Worker	1.14e-06
Fire Training Area	Phenanthrene	Worker	1.40e-02
JP-4 Fill Stands	1,1,2,2-Tetrachloroethane	Worker	1.86e+00
JP-4 Fill Stands	2-Hexanone	Worker	2.43e-01
JP-4 Fill Stands	2-Methylnaphthalene	Worker	3.40e-02
JP-4 Fill Stands	4,4'-DDD	Worker	1.03e-03
JP-4 Fill Stands	4,4'-DDE	Worker	4.80e-04
JP-4 Fill Stands	4,4'-DDT	Worker	3.09e-03
JP-4 Fill Stands	Acenaphthylene	Worker	2.17e-04
JP-4 Fill Stands	Benz(a)anthracene	Worker	5.73e-03
JP-4 Fill Stands	Benzene	Worker	8.36e+01
JP-4 Fill Stands	Benzo(a)pyrene	Worker	4.65e-03

Table D-9
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
JP-4 Fill Stands	Benzo(b)fluoranthene	Worker	6.50e-03
JP-4 Fill Stands	Benzo(g,h,i)perylene	Worker	2.78e-03
JP-4 Fill Stands	Benzo(k)fluoranthene	Worker	5.35e-03
JP-4 Fill Stands	Chrysene	Worker	5.80e-03
JP-4 Fill Stands	Dibenz(a,h)anthracene	Worker	1.30e-03
JP-4 Fill Stands	Indeno(1,2,3-cd)pyrene	Worker	2.28e-03
JP-4 Fill Stands	Lead	Worker	4.28e-02
JP-4 Fill Stands	Pentachlorophenol	Worker	1.26e-03
JP-4 Fill Stands	Phenanthrene	Worker	6.37e-03
Million Gallon Hill	2-Methylnaphthalene	Worker	1.55e-04
Million Gallon Hill	Acenaphthylene	Worker	1.29e-05
Million Gallon Hill	Benz(a)anthracene	Worker	2.30e-04
Million Gallon Hill	Benzo(a)pyrene	Worker	5.03e-04
Million Gallon Hill	Benzo(b)fluoranthene	Worker	1.12e-03
Million Gallon Hill	Benzo(g,h,i)perylene	Worker	2.93e-04
Million Gallon Hill	Dibenz(a,h)anthracene	Worker	6.68e-05
Million Gallon Hill	Indeno(1,2,3-cd)pyrene	Worker	2.69e-04
Million Gallon Hill	Lead	Worker	2.05e+00
Million Gallon Hill	Phenanthrene	Worker	2.57e-04
POL Area	2-Methylnaphthalene	Worker	5.15e-02
POL Area	Benz(a)anthracene	Worker	7.42e-05
POL Area	Benzene	Worker	2.74e+03
POL Area	Benzo(a)pyrene	Worker	5.00e-05
POL Area	Benzo(b)fluoranthene	Worker	6.21e-05
POL Area	Benzo(g,h,i)perylene	Worker	5.35e-05
POL Area	Dibenz(a,h)anthracene	Worker	2.58e-05
POL Area	Dieldrin	Worker	1.84e-05
POL Area	Lead	Worker	1.34e-01
POL Area	Phenanthrene	Worker	5.04e-04
Power Plant	2-Hexanone	Worker	1.87e+00
Power Plant	2-Methylnaphthalene	Worker	1.24e-02
Power Plant	alpha-BHC	Worker	8.23e-06
Power Plant	Aluminum	Worker	5.66e+00
Power Plant	Arsenic	Worker	5.15e-03
Power Plant	Beryllium	Worker	1.60e-04
Power Plant	Dieldrin	Worker	6.18e-06
Power Plant	gamma-BHC	Worker	2.57e-05
Power Plant	Heptachlor epoxide	Worker	6.18e-06
Power Plant	Lead	Worker	2.22e-02

Table D-9
(Continued)

Site	Chemical	Receptor Class	Maximum Predicted Concentration (ug/m^3)
Power Plant	Manganese (food)	Worker	2.26e-01
Waste Accumulation Area	2-Methylnaphthalene	Worker	3.96e-05
Waste Accumulation Area	4,4'-DDD	Worker	5.24e-03
Waste Accumulation Area	4,4'-DDE	Worker	3.97e-04
Waste Accumulation Area	4,4'-DDT	Worker	7.01e-03
Waste Accumulation Area	Aldrin	Worker	1.01e-05
Waste Accumulation Area	Benz(a)anthracene	Worker	5.32e-04
Waste Accumulation Area	Benzo(a)pyrene	Worker	4.26e-04
Waste Accumulation Area	Benzo(b)fluoranthene	Worker	4.55e-04
Waste Accumulation Area	Benzo(g,h,i)perylene	Worker	2.20e-04
Waste Accumulation Area	Dibenz(a,h)anthracene	Worker	1.42e-04
Waste Accumulation Area	Dieldrin	Worker	2.44e-04
Waste Accumulation Area	gamma-BHC	Worker	9.45e-06
Waste Accumulation Area	Heptachlor epoxide	Worker	1.59e-06
Waste Accumulation Area	Indeno(1,2,3-cd)pyrene	Worker	1.99e-04
Waste Accumulation Area	Lead	Worker	2.09e-01
Waste Accumulation Area	Phenanthrene	Worker	7.42e-04

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APPENDIX E

Human Health Exposure Point Concentrations

APPENDIX E
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Table E-1
Exposure Point Concentrations for Fire Protection Training Area

Analyte	Ambient Air Concentrations (ug/m3)							Soil Concentrations (mg/kg)	
	On-Base Residents *a&c*	Galena Residents: Old Town	Galena Residents: New Town	Boarding School Students	On-Base Workers *b&c*	Construction Workers: Average *d*	Construction Workers: RME *e*	On-Base Workers *b&c* (surface soil)	Construction Workers *c* (mixed soil)
Dioxins									
HpCDD Totals	9.69E-12	7.13E-11	3.36E-11	8.61E-12	8.07E-08	1.74E-07	1.78E-07	1.37E-04	1.37E-04
OCDD	6.33E-11	4.66E-10	2.20E-10	5.63E-11	5.27E-07	1.14E-06	1.17E-06	6.54E-04	6.54E-04
Metals									
Lead	5.80E-06	4.27E-05	2.01E-05	5.16E-06	4.84E-02	1.04E-01	1.07E-01	5.99E+01	5.99E+01
PNAs									
Acenaphthylene	1.40E-08	1.03E-07	4.86E-08	1.25E-08	1.17E-04	2.52E-04	2.58E-04	1.45E-01	1.45E-01
Benz(a)anthracene *f*	--	--	--	--	--	7.69E-04	7.90E-04	--	1.40E+00
Benzo(b)fluoranthene *f*	--	--	--	--	--	3.30E-04	3.39E-04	--	1.90E-01
Benzo(a)pyrene	1.68E-09	1.23E-08	5.81E-09	1.49E-09	1.40E-05	5.20E-04	5.34E-04	2.70E-02	2.99E-01
Benzo(g,h,i)perylene	4.55E-09	3.35E-08	1.58E-08	4.05E-09	3.79E-05	1.62E-04	1.66E-04	4.70E-02	7.50E-01
Dibenz(a,h)anthracene *f*	--	--	--	--	--	2.78E-05	2.85E-05	--	2.60E-01
Phenanthrene	7.83E-07	5.77E-06	2.72E-06	6.96E-07	6.52E-03	1.40E-02	1.44E-02	1.60E+01	1.60E+01
Pesticides									
4,4-DDT	3.87E-08	2.85E-07	1.34E-07	3.44E-08	3.23E-04	6.95E-04	7.14E-04	4.00E-01	4.00E-01
Aldrin	9.13E-10	6.72E-09	3.17E-09	8.11E-10	7.61E-06	1.64E-05	1.68E-05	9.43E-03	9.43E-03
Heptachlor epoxide	2.96E-10	2.18E-09	1.03E-09	2.63E-10	2.47E-06	5.31E-06	5.45E-06	3.06E-03	3.06E-03
Semi-Volatiles									
2-Hexanone	1.77E-03	1.30E-02	6.13E-03	1.57E-03	1.47E+01	8.16E+00	8.38E+00	2.42E+00	2.42E+00
Volatiles									
Benzene *g*	3.51E-05	2.59E-04	1.22E-04	3.12E-05	2.93E-01	1.26E+02	1.29E+02	--	2.82E+01

a On-base residents include caretakers and long term base residents.
b On-base workers include both long-term and short-term workers.
c Data for average and reasonable maximum scenario are the same.
d Concentrations determined after exposure for 3 months.
e Concentrations determined after exposure for 6 months.
f Chemical was only found in subsurface soil.
g Because benzene is a volatile, it is assumed that vapor emissions would reach the surface even though benzene was only found in subsurface soil.
NOTE: Mixed soil concentrations were determined by taking the higher value of surface or subsurface soil concentrations.

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Table E-2
Exposure Point Concentrations for POL Tank Farm

Analyte	Ambient Air Concentrations (ug/m3)							Soil Concentrations (mg/kg)	
	On-Base Residents *a&c*	Galena Residents Old Town	Galena Residents New Town	Boarding School Students	On-Base Workers *b&c*	Construction Workers Average *d*	Construction Workers RME *e*	On-Base Workers *b&c* and Boarding School Students (surface soil)	Construction Workers *c* (mixed soil)
Metals									
Lead	8.81E-05	8.96E-06	5.98E-07	4.54E-04	1.71E-03	1.34E-01	1.38E-01	7.12E+00	7.12E+00
PNAs									
2-Methylnaphthalene	1.22E-05	1.24E-06	8.30E-08	6.30E-05	2.38E-04	5.15E-02	5.31E-02	1.19E+01	3.29E+01
Benz(a)anthracene	4.87E-08	4.95E-09	3.30E-10	2.51E-07	9.46E-07	7.42E-05	7.64E-05	3.70E-01	3.70E-01
Benzo(a)pyrene	3.28E-08	3.33E-09	2.22E-10	1.69E-07	6.37E-07	5.00E-05	5.15E-05	3.19E-02	3.19E-02
Benzo(b)fluoranthene	4.07E-08	4.14E-09	2.76E-10	2.10E-07	7.92E-07	6.21E-05	6.40E-05	1.80E-01	1.80E-01
Benzo(g,h,i)perylene	3.51E-08	3.57E-09	2.38E-10	1.81E-07	6.82E-07	5.35E-05	5.51E-05	1.50E-01	1.50E-01
Dibenz(a,h)anthracene	1.69E-08	1.72E-09	1.15E-10	8.72E-08	3.29E-07	2.58E-05	2.66E-05	1.64E-02	1.64E-02
Phenanthrene	3.31E-07	3.36E-08	2.24E-09	1.71E-06	6.43E-06	5.04E-04	5.19E-04	3.21E-01	3.21E-01
Pesticides									
Dieldrin	1.20E-08	1.22E-09	8.17E-11	6.21E-08	2.34E-07	1.84E-05	1.89E-05	1.17E-02	1.17E-02
Volatiles									
Benzene *f*	2.17E-01	2.21E-02	1.47E-03	1.12E+00	4.22E+00	2.74E+03	2.82E+03	--	3.40E+02

a On-base residents include caretakers and long term base residents.
b On-base workers include both long-term and short-term workers.
c Data for average and reasonable maximum scenario are the same.
d Concentrations determined after exposure for 3 months.
e Concentrations determined after exposure for 6 months.
f Because benzene is a volatile, it is assumed vapor emissions would reach the surface even though benzene was only found in subsurface soil.
NOTE: Mixed soil concentrations were determined by taking the higher value of surface or subsurface soil concentrations.

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Table E-3
Exposure Point Concentrations for West Unit

Analyte	Ambient Air Concentrations (ug/m3)							Soil Concentrations (mg/kg)	
		Galena Residents		Boarding		Construction Workers		On-Base	Construction
	On-Base Residents *a&c*	Old Town	New Town	School Students	On-Base Workers *b&c*	Average *d*	RME *e*	Workers *b&c* (surface soil)	Workers *c* (mixed soil)
Metals									
Aluminum	2.33E-05	4.37E-06	3.26E-07	1.95E-05	7.08E-02	7.39E+00	7.59E+00	1.08E+04	1.11E+04
Arsenic	6.11E-08	5.60E-09	4.80E-10	3.98E-08	6.36E-05	6.36E-03	6.53E-03	2.18E+01	2.18E+01
Beryllium	5.94E-10	1.11E-10	8.29E-12	4.96E-10	9.01E-07	2.01E-04	2.06E-04	1.80E-01	2.82E-01
Lead	2.46E-04	1.05E-04	6.69E-06	2.10E-04	5.77E-03	3.96E-01	4.08E-01	3.27E+02	3.27E+02
Manganese (food)	9.34E-07	1.75E-07	1.30E-08	7.80E-07	2.83E-03	3.36E-01	3.46E-01	2.35E+02	4.42E+02
PNAs									
2-Methylnaphthalene	5.09E-08	1.06E-08	7.10E-10	4.25E-08	3.26E-05	1.38E-02	1.42E-02	4.97E+00	1.64E+01
Acenaphthylene	7.69E-09	3.70E-09	2.00E-10	9.42E-09	5.05E-07	3.83E-05	3.91E-05	3.37E-02	3.37E-02
Benz(a)anthracene	2.03E-07	9.76E-08	5.28E-09	2.48E-07	1.51E-05	1.08E-03	1.10E-03	1.02E+00	1.02E+00
Benzo(a)pyrene	1.65E-07	7.93E-08	4.29E-09	2.02E-07	1.30E-05	9.30E-04	9.50E-04	2.74E+00	2.74E+00
Benzo(b)fluoranthene	2.30E-07	1.11E-07	5.99E-09	2.82E-07	1.89E-05	1.35E-03	1.38E-03	2.82E+00	2.82E+00
Benzo(g,h,i)perylene	9.86E-08	4.75E-08	2.57E-09	1.21E-07	7.70E-06	5.50E-04	5.61E-04	5.26E-01	5.26E-01
Benzo(k)fluoranthene	1.89E-07	9.11E-08	4.93E-09	2.32E-07	1.24E-05	8.91E-04	9.09E-04	1.06E+00	1.06E+00
Chrysene	2.05E-07	9.88E-08	5.34E-09	2.51E-07	1.35E-05	9.66E-04	9.85E-04	3.39E+00	3.39E+00
Dibenz(a,h)anthracene	4.59E-08	2.21E-08	1.19E-09	5.62E-08	3.34E-06	2.51E-04	2.56E-04	2.24E-01	2.24E-01
Indeno(1,2,3-cd)pyrene	8.08E-08	3.89E-08	2.10E-09	9.90E-08	6.43E-06	4.58E-04	4.68E-04	1.39E+00	1.39E+00
Phenanthrene	2.25E-07	1.08E-07	5.87E-09	2.76E-07	1.72E-05	1.31E-03	1.33E-03	3.60E+00	3.60E+00
Pesticides									
4,4-DDD	1.88E-07	4.68E-08	3.25E-09	1.87E-07	1.84E-05	3.11E-03	3.19E-03	1.38E+00	2.12E+00
4,4-DDE	1.70E-08	8.18E-09	4.43E-10	2.08E-08	2.56E-06	1.75E-04	1.79E-04	6.33E-01	6.33E-01
4,4-DDT	2.51E-07	6.27E-08	4.35E-09	2.50E-07	2.96E-05	2.71E-03	2.77E-03	2.76E+00	2.76E+00
Aldrin	3.62E-10	9.04E-11	6.27E-12	3.61E-10	2.97E-08	2.02E-06	2.07E-06	2.41E-03	2.41E-03
alpha-BHC	3.40E-11	6.36E-12	4.73E-13	2.84E-11	2.57E-08	1.65E-06	1.69E-06	4.51E-03	4.51E-03
Dieldrin	8.74E-09	2.18E-09	1.51E-10	8.71E-09	7.32E-07	5.00E-05	5.11E-05	1.25E-01	1.25E-01
gamma-BHC	3.39E-10	8.45E-11	5.86E-12	3.37E-10	2.78E-08	7.04E-06	7.21E-06	6.37E-03	1.02E-02
Heptachlor epoxide	5.70E-11	1.42E-11	9.86E-13	5.68E-11	4.68E-09	1.55E-06	1.59E-06	3.31E-03	3.31E-03

Table E-3
(Continued)

Analyte	Ambient Air Concentrations (ug/m3)							Soil Concentrations (mg/kg)	
	On-Base Residents *a&c*	Galena Residents		Boarding School Students	On-Base Workers *b&c*	Construction Workers		On-Base Workers *b&c* (surface soil)	Construction Workers *c* (mixed soil)
		Old Town	New Town			Average *d*	RME *e*		
Semi-Volatiles									
2-Hexanone	1.17E-03	2.18E-04	1.62E-05	9.73E-04	5.89E-01	3.52E-01	3.61E-01	2.80E-01	2.80E-01
bis(2-Ethylhexyl)phthalate *f*	--	--	--	--	--	2.45E-03	2.51E-03		4.92E+00
Pentachlorophenol	4.46E-08	2.14E-08	1.16E-09	5.46E-08	2.92E-06	2.52E-04	2.57E-04	1.96E-01	1.96E-01
Volatiles									
1,1,2,2-Tetrachloroethane *g*	1.11E-05	5.35E-06	2.89E-07	1.36E-05	6.08E-04	3.10E-01	3.16E-01	--	2.33E-01
Benzene	4.17E-02	3.82E-03	3.27E-04	2.72E-02	7.26E+00	4.51E+01	4.62E+01	1.32E+00	1.33E+01

a On-base residents include caretakers and long term base residents.
b On-base workers include both long-term and short-term workers.
c Data for average and reasonable maximum scenario are the same.
d Concentrations determined after exposure for 3 months.
e Concentrations determined after exposure for 6 months.
f Analyte was found in subsurface soil only.
g Analyte was found in subsurface soil only. Because the analyte is a volatile, it is assumed vapors will reach the surface.

Table E-4

West Unit Surface Soil Exposure Concentrations

Chemical	Surface Soil 95% UCL (mg/kg) *a* WAA	MGH	PP UST #4	JP-4 Fillstands	Bldg 1845	Bldg 1700	Average (mg/kg)
2-Hexanone	0	0	**1.4 *b***	0	--	0	2.80E-01
2-Methylnaphthalene	**0.01626**	**0.031134**	**24 *b***	**0.4843**	--	**0.044 *b***	4.92E+00
4,4'-DDD	**4.61**	0.046 *b*	0.057 *b*	**0.802**	--	--	1.38E+00
4,4'-DDE	**0.349**	0.014 *b*	0.017 *b*	**0.3729**	--	--	1.88E-01
4,4'-DDT	**6.167**	0.14	0.015 *b*	**2.399**	--	--	2.18E+00
Acenaphthylene	0	0	0	**0.1687**	--	0	3.37E-02
Aldrin	**0.00889**	0.000089 *b*	0	0.00064	--	--	2.41E-03
alpha-BHC	0.00052	0.0013	**0.016 *b***	0.00022	--	--	4.51E-03
Aluminum	6300	11000	**11000 *b***	15000	--	--	1.08E+04
Arsenic	40	12	32 *b*	17	--	**8.09 *b***	2.18E+01
Benz(a)anthracene	**0.4684**	**0.146901**	0	**4.447**	--	0	1.01E+00
Benzene	0	0.00056	0	0.00073	--	**6.6 *b***	1.32E+00
Benzo(a)pyrene	**0.37452**	**0.321 *b***	0	**3.613**	--	0	8.62E-01
Benzo(b)fluoranthene	**0.40001**	**0.717**	0	**5.051**	--	0	1.23E+00
Benzo(g,h,i)perylene	**0.19377**	**0.1869**	0	**2.1624**	--	0	5.09E-01
Benzo(k)fluoranthene	0.4	0.72 *b*	0	**4.1516**	--	0	1.05E+00
Beryllium	0.14	0.3	**0.28 *b***	0	--	--	1.80E-01
Chrysene	0.57	0.4 *b*	0	**4.5002**	--	0	1.09E+00
Dibenz(a,h)anthracene	**0.12471**	0	0	**1.006**	--	0	2.26E-01
Dieldrin	**0.2146**	0.0013	**0.0088 *b***	0	--	--	5.62E-02
gamma-BHC	**0.00831**	0.0017 *b*	0.015 *b*	0.00048	--	--	6.37E-03
Heptachlor epoxide	**0.0014**	0.0015	0	0.00073	--	--	9.08E-04
Indeno(1,2,3-cd)pyrene	**0.17547**	**0.1716**	0	**1.7723**	--	0	4.24E-01
Lead	**184.158**	**1306.965**	**43.2 *b***	**33.27**	--	**76.8 *b***	3.29E+02
Manganese	240	480	**440 *b***	16	--	--	2.35E+02
Pentachlorophenol	0	0	0	**0.9769**	--	0	1.95E-01
Phenanthrene	**0.6525**	0.1639	0	**4.9436**	--	0	1.15E+00

a If the maximum detected concentration is lower than the 95% UCL, it is reported instead of the UCL.
A value of 0 is reported only if the chemical was not detected in any samples from that source area.
b Maximum detected concentration.
-- = Analyte was not tested in medium.
NOTE: If the value is printed in bold type, the chemical was identified as a COPC in that source area.

WAA = Waste Accumulation Area
MGH = Million Gallon Hill
PP = Power Plant
UST = Underground Storage Tank

Table E-5

West Unit Subsurface Soil Exposure Concentrations

Chemical	Subsurface Soil 95% UCL (mg/kg) *a*						Average (mg/kg)
	WAA	MGH	PP UST #49	JP-4 Fillstands	Bldg 1845	Bldg 1700	
1,1,2,2-Tetrachloroethane	0	0	0	**1.436**	0	0	2.39E-01
2-Hexanone	0	0	0	**0.0727**	0	0	1.21E-02
2-Methylnaphthalene	**0.0348**	**0.0989**	**15 *b***	**26.407**	**0.11 *b***	**56.7 *b***	1.64E+01
4,4'-DDD	0.035 *b*	0.021 *b*	0.24 *b*	**0.29 *b***	**10 *b***	--	2.12E+00
4,4'-DDT	0.022	0.037 *b*	0.038 *b*	**0.37 *b***	**3.7 *b***	--	8.33E-01
Acenaphthylene	0	**0.00821**	0	0	0	0	1.37E-03
alpha-BHC	0.00035	0	**0.011 *b***	0	0.0018 *b*	--	2.63E-03
Aluminum	11000	12000	**9900 *b***	13000	**9800 *b***	--	1.11E+04
Arsenic	11	10	**10 *b***	10	**9.3 *b***	**8.23 *b***	9.76E+00
Benz(a)anthracene	0.02	**0.0761**	0	0.016	0	0	1.87E-02
Benzene	0	0.0049	0	**12.005**	0	**68 *b***	1.33E+01
Benzo(a)pyrene	**0.0201**	**0.124**	0	**0.038**	0	0	3.04E-02
Benzo(b)fluoranthene	0.024	**0.278**	0	**0.0293**	0	0	5.52E-02
Benzo(g,h,i)perylene	0	**0.0759**	0	**0.0201335**	0	0	1.60E-02
Beryllium	0.28	0.27	**0.31 *b***	0.29	**0.26 *b***	--	2.82E-01
bis(2-Ethylhexyl)phthalate	0.025	0.98 *b*	3.1 *b*	2.4 *b*	0	**22.9 *b***	4.90E+00
Dibenz(a,h)anthracene	0	**0.0426**	0	0	0	0	7.10E-03
Dieldrin	0.00037	0.0004 *b*	**0.012 *b***	0.0011 *b*	0	--	2.77E-03
gamma-BHC	0.00057	0	**0.05 *b***	0	0.00065 *b*	--	1.02E-02
Heptachlor epoxide	0.00035	0	**0.012 *b***	0.00015 *b*	0.0013 *b*	--	2.76E-03
Indeno(1,2,3-cd)pyrene	0	**0.0412**	0	0.03 *b*	0	0	1.19E-02
Lead	12 *b*	12	**9.5 *b***	3	**8.1 *b***	**19 *b***	1.06E+01
Manganese	420	450	**370 *b***	490	**480 *b***	--	4.42E+02
Phenanthrene	**0.0236**	**0.133**	0	**0.1001**	0	**0.736 *b***	1.65E-01

a If the maximum detected concentration is lower than the 95% UCL, it is reported instead of the UCL.
A value of 0 is reported only if the chemical was not detected in any samples from that source area.
b Maximum detected concentration.
-- = Analyte was not tested in medium.
NOTE: If the value is printed in bold type, the chemical was identified as a COPC in that source area.

WAA = Waste Accumulation Area
MGH = Million Gallon Hill
PP = Power Plant
UST = Underground Storage Tanks

Table E-6

West Unit Fugitive Dust/Vapors Air Exposure Concentrations for On-Base Workers

Chemical	Modeled Air Concentrations (ug/m3)						Average
	WAA	MGH	PP UST #49	JP-4 Fillstands	Bldg 1845	Bldg 1700	(ug/m3)
1,1,2,2-Tetrachloroethane	0	0	0	3.65E-03	0	0	6.08E-04
2-Hexanone	0	0	3.53E+00	1.64E-04	0	0	5.89E-01
2-Methylnaphthalene	2.17E-07	5.96E-07	1.54E-04	7.24E-06	--	3.46E-07	3.26E-05
4,4-DDD	6.17E-05	0	0	1.20E-05	--	--	1.84E-05
4,4-DDE	4.67E-06	0	0	5.58E-06	--	--	2.56E-06
4,4-DDT	8.25E-05	0	0	3.59E-05	--	--	2.96E-05
Acenaphthylene	0	0	0	2.52E-06	--	0	5.05E-07
Aldrin	1.19E-07	0	0	0	--	--	2.97E-08
alpha-BHC	0	0	1.03E-07	0	--	--	2.57E-08
Aluminum	*	*	7.08E-02	*	--	--	7.08E-02
Arsenic	*	*	*	*	--	6.36E-05	6.36E-05
Benz(a)anthracene	6.27E-06	2.81E-06	0	6.65E-05	--	0	1.51E-05
Benzene	0	0	0	1.20E-01	0	4.34E+01	7.26E+00
Benzo(a)pyrene	5.01E-06	6.15E-06	0	5.40E-05	--	0	1.30E-05
Benzo(b)fluoranthene	5.35E-06	1.37E-05	0	7.55E-05	--	0	1.89E-05
Benzo(g,h,i)perylene	2.59E-06	3.58E-06	0	3.23E-05	--	0	7.70E-06
Benzo(k)fluoranthene	0	0	0	6.21E-05	--	0	1.24E-05
Beryllium	*	*	1.80E-06	0	--	--	9.01E-07
Chrysene	0	0	0	6.73E-05	--	0	1.35E-05
Dibenz(a,h)anthracene	1.67E-06	0	0	1.50E-05	--	0	3.34E-06
Dieldrin	2.87E-06	0	5.66E-08	0	--	--	7.32E-07
gamma-BHC	1.11E-07	0	0	0	--	--	2.78E-08
Heptachlor epoxide	1.87E-08	0	0	0	--	--	4.68E-09
Indeno(1,2,3-cd)pyrene	2.35E-06	3.28E-06	0	2.65E-05	--	0	6.43E-06
Lead	2.46E-03	2.50E-02	2.78E-04	4.98E-04	--	6.04E-04	5.77E-03
Manganese (food/dust)	*	*	2.83E-03	*	--	--	2.83E-03
Pentachlorophenol	0	0	0	1.46E-05	--	0	2.92E-06
Phenanthrene	8.73E-06	3.14E-06	0	7.39E-05	--	0	1.72E-05

* Inorganic chemical that was not a COPC in source area. Not included in calculation of average concentration.

-- Analyte was not tested in medium used to estimate emissions for this scenario. Not included in calculation of average concentration.

WAA = Waste Accumulation Area　　MGH = Million Gallon Hill

PP = Power Plant　　UST = Underground Storage Tank

Table E-7

West Unit Fugitive Dust/Vapors Air Exposure Concentrations for Construction Workers Average Scenario

Chemical	Modeled Air Concentrations (ug/m3)						Average (ug/m3)
	WAA	MGH	PP UST #49	JP-4 Fillstands	Bldg 1845	Bldg 1700	
1,1,2,2-Tetrachloroethane	0	0	0	1.86E+00	0	0	3.10E-01
2-Hexanone	0	0	1.87E+00	2.43E-01	0	0	3.52E-01
2-Methylnaphthalene	3.96E-05	1.55E-04	1.24E-02	3.40E-02	1.02E-04	3.64E-02	1.38E-02
4,4-DDD	5.24E-03	0	0	1.03E-03	9.30E-03	--	3.11E-03
4,4-DDE	3.97E-04	0	0	4.80E-04	0	--	1.75E-04
4,4-DDT	7.01E-03	0	0	3.09E-03	3.44E-03	--	2.71E-03
Acenaphthylene	0	1.29E-05	0	2.17E-04	0	0	3.83E-05
Aldrin	1.01E-05	0	0	0	0	--	2.02E-06
alpha-BHC	0	0	8.23E-06	0	0	--	1.65E-06
Aluminum	*	*	5.66E+00	*	9.11E+00	--	7.39E+00
Arsenic	*	*	5.15E-03	*	8.65E-03	5.28E-03	6.36E-03
Benz(a)anthracene	5.32E-04	2.30E-04	0	5.73E-03	0	0	1.08E-03
Benzene	0	0	0	8.36E+01	0	1.87E+02	4.51E+01
Benzo(a)pyrene	4.26E-04	5.03E-04	0	4.65E-03	0	0	9.30E-04
Benzo(b)fluoranthene	4.55E-04	1.12E-03	0	6.50E-03	0	0	1.35E-03
Benzo(g,h,i)perylene	2.20E-04	2.93E-04	0	2.78E-03	0	0	5.50E-04
Benzo(k)fluoranthene	0	0	0	5.35E-03	0	0	8.91E-04
Beryllium	*	*	1.60E-04	*	2.42E-04	--	2.01E-04
bis(2-Ethylhexyl)phthalate	0	0	0	0	0	1.47E-02	2.45E-03
Chrysene	0	0	0	5.80E-03	0	0	9.66E-04
Dibenz(a,h)anthracene	1.42E-04	6.68E-05	0	1.30E-03	0	0	2.51E-04
Dieldrin	2.44E-04	0	6.18E-06	0	0	--	5.00E-05
gamma-BHC	9.45E-06	0	2.57E-05	0	0	--	7.04E-06
Heptachlor epoxide	1.59E-06	0	6.18E-06	0	0	--	1.55E-06
Indeno(1,2,3-cd)pyrene	1.99E-04	2.69E-04	0	2.28E-03	0	0	4.58E-04
Lead	2.09E-01	2.05E+00	2.22E-02	4.28E-02	7.53E-03	4.93E-02	3.96E-01
Manganese	*	*	2.26E-01	*	4.46E-01	--	3.36E-01
Pentachlorophenol	0	0	0	1.26E-03	--	0	2.52E-04
Phenanthrene	7.42E-04	2.57E-04	0	6.37E-03	0	4.72E-04	1.31E-03

-- Analyte was not tested in medium used to estimate emissions for this scenario. Not included in calculation of average concentration.
* Inorganic chemical that was not a COPC in source area. Not included in calculation of average concentration.

WAA = Waste Accumulation Area
PP = Power Plant
MGH = Million Gallon Hill
UST = Underground Storage Tank

TABE-7.XLS 2/19/96

Ta[illegible]e E-8

West Unit Fugitive Dust/Vapors Air Exposure Concentrations for Construction Workers Reasonable Maximum Scenario

	Modeled Air Concentrations (ug/m3)						Average
Chemical	WAA	MGH	PP UST #49	JP-4 Fillstands	Bldg 1845	Bldg 1700	(ug/m3)
1,1,2,2-Tetrachloroethane	0	0	0	1.90E+00	0	0	3.16E-01
2-Hexanone	0	0	1.92E+00	2.48E-01	0	0	3.61E-01
2-Methylnaphthalene	4.05E-05	1.59E-04	1.27E-02	3.47E-02	1.05E-04	3.73E-02	1.42E-02
4,4-DDD	5.36E-03	0	0	1.05E-03	9.56E-03	--	3.19E-03
4,4-DDE	4.06E-04	0	0	4.90E-04	0	--	1.79E-04
4,4-DDT	7.17E-03	0	0	3.15E-03	3.54E-03	--	2.77E-03
Acenaphthylene	0	1.32E-05	0	2.22E-04	0	0	3.91E-05
Aldrin	1.03E-05	0	0	0	0	--	2.07E-06
alpha-BHC	0	0	8.45E-06	0	0	--	1.69E-06
Aluminum	*	*	5.81E+00	*	9.37E+00	--	7.59E+00
Arsenic	*	*	5.28E-03	*	8.89E-03	5.42E-03	6.53E-03
Benz(a)anthracene	5.44E-04	2.37E-04	0	5.84E-03	0	0	1.10E-03
Benzene	0	0	0	8.53E+01	0	1.92E+02	4.62E+01
Benzo(a)pyrene	4.35E-04	5.17E-04	0	4.75E-03	0	0	9.50E-04
Benzo(b)fluoranthene	4.65E-04	1.16E-03	0	6.63E-03	0	0	1.38E-03
Benzo(g,h,i)perylene	2.25E-04	3.01E-04	0	2.84E-03	0	0	5.61E-04
Benzo(k)fluoranthene	0	0	0	5.45E-03	0	0	9.09E-04
Beryllium	*	*	1.64E-04	*	2.49E-04	--	2.06E-04
bis(2-Ethylhexyl)phthalate	0	0	0	0	0	1.51E-02	2.51E-03
Chrysene	0	0	0	5.91E-03	0	0	9.85E-04
Dibenz(a,h)anthracene	1.45E-04	6.87E-05	0	1.32E-03	0	0	2.56E-04
Dieldrin	2.49E-04	0	6.33E-06	0	0	--	5.11E-05
gamma-BHC	9.66E-06	0	2.64E-05	0	0	--	7.21E-06
Heptachlor epoxide	1.63E-06	0	6.33E-06	0	0	--	1.59E-06
Indeno(1,2,3-cd)pyrene	2.04E-04	2.77E-04	0	2.33E-03	0	0	4.68E-04
Lead	2.14E-01	2.11E+00	2.28E-02	4.37E-02	7.75E-03	5.06E-02	4.08E-01
Manganese (food/dust)	*	*	2.32E-01	--	4.59E-01	--	3.46E-01
Pentachlorophenol	0	0	0	1.28E-03	--	0	2.57E-04
Phenanthrene	7.58E-04	2.64E-04	0	6.49E-03	0	4.84E-04	1.33E-03

-- Analyte was not tested in medium used to estimate emissions for this scenario. Not included in calculation of average concentration.
* Inorganic chemical that was not a COPC in source area. Not included in calculation of average concentration.

WAA = Waste Accumulation Area
PP = Power Plant
MGH = Million Gallon Hill
UST = Underground Storage Tank

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Appendix F

Human Health Intake Equations and Exposure Parameters

APPENDIX F
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Note: This appendix lists intake equations and exposure parameters that were proposed in the *Human and Ecological Baseline Risk Assessment Protocol for Galena Airport and Campion Air Force Station, Alaska* (USAF, 1995) and revised in response to ADEC comments and in accordance with discussions that occurred at a 4/19/95 meeting attended by representatives of ADEC, Shannon & Wilson (ADEC Contractor), USAF, and Radian Corporation (USAF contractor). Some of the intake equations listed in this appendix may not apply to sites that are the subject of this risk assessment report.

Table F-1
General Parameters

Exposure Parameter	Value		Selection Rationale (Reference)
GENERAL PARAMETERS			
Averaging Time (AT)			
Non-carcinogens	Varies	days	Calculated as ED x 365 days/yr (USUSEPA, 1989a).
Carcinogens	25550	days	Default value = 70 yrs x 365 days/yr (USEPA, 1989a).
Body Weight (BW)			
Adult Residents	70	kg	Default value for adults (USEPA, 1991a).
Child Residents	15	kg	Default value for children (USEPA, 1991a).
All Workers	70	kg	Default value for adults (USEPA, 1991a).
Boarding Students			
- Average	61.2	kg	Calculated mean for high school aged boys and girls 15-18 years old (USEPA, 1989b).
- Reasonable Maximum	48.6	kg	Calculated mean for boys and girls 6-20 years old, elementary through high school (USEPA, 1989b).
Exposure Duration (ED)			
Average			
On-Base Residents			
Short Term	2	yr	Caretaker expected to live on the base from 2 to 5 years.
Long Term - Adult	9	yr	National average time at one residence (USEPA, 1989b).
Long Term - Child	6	yr	Default value (USEPA, 1991a).
Galena Residents			
Adult	24.5	yr	Average length of residency in Galena (ADF&G, 1990).
Child	6	yr	Default value (USEPA, 1991a).
On-Base Workers			
Short Term	2	yr	Caretaker expected to work from 2 to 5 years on the base.
Long Term	25	yr	Default value (USEPA, 1991a).
Construction Workers	0.25	yr	Assumes construction will last 3 to 6 months.
Boarding Students	4	yr	Assumes student attends grades 9-12 at boarding school.
Reasonable Maximum			
On-Base Residents			
Short Term	5	yr	Caretaker expected to live on the base from 2 to 5 years.
Long Term - Adult	25	yr	Default value (USEPA, 1991a).
Long Term - Child	6	yr	Default value; from birth to 6 years (USEPA, 1991a).
Galena Residents			
Adult	70	yr	Based on lifetime residency in Galena.
Child	6	yr	Default value; from birth to 6 years (USEPA, 1991a).
On-Base Workers			
Short Term	5	yr	Caretaker expected to work from 2 to 5 years on the base.
Long Term	25	yr	Default value (USEPA, 1991a).
Construction Workers	0.5	yr	Assumes construction will last 3 to 6 months.
Boarding Students	14	yr	Assumes student attends grades 1-12 at boarding school and repeats two years at same school.

Table F-2
Ingestion of Soil

Exposure Parameter	Value		Selection Rationale (Reference)
			INGESTION OF SOIL
			Intake (mg/kg-day) = (Cs x IR x F x EF x ED x CF) / (BW x AT)
Concentration in Soil (Cs)	Varies	mg/kg	Chemical-specific value.
Ingestion Rate (IR)			
Average			
All Workers	50	mg/day	Default value for workers (USEPA, 1991a).
Boarding Students	100	mg/day	Amount consumed by individuals 7 years and older (USEPA, 1991a).
Reasonable Maximum			
Short Term Workers	50	mg/day	Default value for workers (USEPA, 1991a).
Long Term Workers	50	mg/day	Default value for workers (USEPA, 1991a).
Construction Workers	480	mg/day	Default value for construction workers (USEPA, 1991a).
Boarding Students	100	mg/day	Amount consumed by individuals 7 years and older (USEPA, 1991a).
Faction Ingested from Contaminated Source (F)			
Average & Reasonable Maximum			
All Workers	1	unitless	Assumes 100% from contaminated source.
Boarding Students	1	unitless	Assumes 100% from contaminated source.
Exposure Frequency (EF)			
Average & Reasonable Maximum			
On-Base Workers	150	day/yr	Assumes 250 work days a year, 100 days (5 months x 20 days/month) of snow cover, and that the snow will prevent direct contact with soil.
Construction Workers	260	day/yr	Number of work days a year. Since the exposure duration (page 1) is 3-6 months, exposure is limited to the days when soil is not snow-covered.
Boarding Students	120	day/yr	Assumes students board for 270 days a year (9 months), 150 days (5 months) of snow cover, and that the snow will prevent direct contact with soil.
Conversion Factor (CF)	0.000001	kg/mg	

Note: (ED), (BW) and (AT) are general parameters. Please refer to page 1 for their values.

Table F-3
Ingestion of Groundwater

Exposure Parameter	Value		Selection Rationale (Reference)
INGESTION OF GROUNDWATER** *Intake (mg/kg-day) = (Cw x IR x EF x ED) / (BW x AT)*			
Concentration in Water (Cw)	Varies	mg/L	Chemical-specific value.
Ingestion Rate (IR)			
Average			
Adult Residents	1.4	L/day	Adult average (USEPA, 1989b).
Child Residents	1	L/day	Default value for children (USEPA, 1991a).
Reasonable Maximum			
Adult Residents	2	L/day	Default value for adults (USEPA, 1991a).
Child Residents	1	L/day	Default value for children (USEPA, 1991a).
Exposure Frequency (EF)			
Average			
All Residents	275	day/yr	On average, people spend 75% of their time at home. 75 percent of a full year equals 275 days/year (USEPA, 1991a).
Reasonable Maximum			
All Residents	350	day/yr	Default value; 365 days/year minus 2 weeks vacation (USEPA, 1991a).

**** This pathway is only applicable if groundwater modeling shows Old Town Galena to be downgradient of the base.**

Note: (ED), (BW) and (AT) are general parameters. Please refer to page 1 for their values.

Table X-4
Ingestion of Fruit

Exposure Parameter	Value		Selection Rationale (Reference)
INGESTION OF FRUIT			
Intake (mg/kg-day) = (Cf x IR x F x EF x ED) / (BW x AT)			
Concentration in Fruit (Cf)	Varies	mg/kg	Chemical-specific value.
Ingestion Rate (IR)*			
Average			
Adults	0.17	kg/day	Based on daily intake rate for fruit (Pao *et al*., 1982).
Children	0.13	kg/day	Based on daily intake rate for fruit (Pao *et al*., 1982).
Reasonable Maximum			
Adults	0.24	kg/day	Based on daily intake rate for fruit (Pao *et al*., 1982).
Children	0.19	kg/day	Based on daily intake rate for fruit (Pao *et al*., 1982).
Faction Ingested from Contaminated Source (F)*			
Average	0.2	unitless	Average fraction of fruit eaten that is home grown (USEPA, 1989a).
Reasonable Maximum	0.3	unitless	Worst-case fraction of fruit eaten that is home grown (USEPA, 1989a).
Exposure Frequency (EF)			
Average	275	days/yr	On average, people spend 75% of their time at home. 75 percent of a full year equals 275 days/year (USEPA Region X, 1991b).
Reasonable Maximum	350	days/yr	Default value; 365 days/year minus 2 weeks vacation (USEPA, 1991a).

Note: (ED), (BW) and (AT) are general parameters. Please refer to page 1 for their values.
*** Site specific values for the Galena area, if available, will replace national values.**

Table F-5
Ingestion of Vegetables

Exposure Parameter	Value		Selection Rationale (Reference)
	INGESTION OF VEGETABLES		
	Intake (mg/kg-day) = (Cv x IR x F x EF x ED) / (BW x AT)		
Concentration in Vegetables (Cv)	Varies	mg/kg	Chemical-specific value.
Ingestion Rate (IR)*			
Average			
Adults	0.11	kg/day	Based on daily intake rate for vegetables (Pao *et al*., 1982).
Children	0.18	kg/day	Based on daily intake rate for vegetables (Pao *et al*., 1982).
Reasonable Maximum			
Adults	0.14	kg/day	Based on daily intake rate for vegetables (Pao *et al*., 1982).
Children	0.19	kg/day	Based on daily intake rate for vegetables (Pao *et al*., 1982).
Faction Ingested from Contaminated Source (F)*			
Average	0.25	unitless	Average fraction of vegetables eaten that is home grown (USEPA, 1989a).
Reasonable Maximum	0.4	unitless	Worst-case fraction of vegetables eaten that is home grown (USEPA, 1989a).
Exposure Frequency (EF)			
Average	275	days/yr	On average, people spend 75% of their time at home. 75 percent of a full year equals 275 days/year (USEPA Region X, 1991b).
Reasonable Maximum	350	days/yr	Default value; 365 days/year minus 2 weeks vacation (USEPA, 1991a).

Note: (ED), (BW) and (AT) are general parameters. Please refer to page 1 for their values.
*** Site specific values for the Galena area, if available, will replace national values.**

Table F-6
Dermal Contact with Soil

Exposure Parameter	Value		Selection Rationale (Reference)
DERMAL CONTACT WITH SOIL			
Absorbed Dose (mg/kg-day) = (Cs x SA x AF x ABS x EF x ED x CF) / (BW x AT)			
Concentration in Soil (Cs)	Varies	mg/kg	Chemical-specific value.
Skin Surface Area (SA)			
Average			
All Workers	5000	cm^2/day	Recommended value for dermal exposure to soil. Calculated as 25% of the adult mean skin SA (USEPA, 1992).
Boarding Students	4375	cm^2/day	Calculated as 25% of the total SA, 50th percentile value, for males 15 to 18 years old (USEPA, 1992).
Reasonable Maximum			
All Workers	5000	cm^2/day	Recommended value for dermal exposure to soil. Calculated as 25% of the adult mean skin SA (USEPA, 1992).
Boarding Students	3113	cm^2/day	Calculated as 25% of the total SA, 50th percentile value, for males 6 to 19 years old (USEPA, 1992).
Adherence Factor (AF)			
Average	0.6	mg/cm^2	Default value (USEPA Region X, 1991b).
Reasonable Maximum	1	mg/cm^2	Recommended reasonable upper value (USEPA, 1992).
Absorption Factor (ABS)	Varies	unitless	Chemical-specific value.
	1%	unitless	Default value for inorganic chemicals in the absence of specific data.
	10%	unitless	Default value for organic chemicals in the absence of specific data.
Exposure Frequency (EF)			
Average & Reasonable Maximum			
On-Base Workers	150	day/yr	Assumes 250 work days a year, 100 days (5 months x 20 days/month) of snow cover, and that the snow will prevent direct contact with soil.
Construction Workers	260	day/yr	Number of work days a year. Since the exposure duration (page 1) is 3-6 months, exposure is limited to the days when soils are not snow-covered.
Boarding Students	120	day/yr	Assumes students board for 270 days a year (9 months), 150 days (5 months) of snow cover, and that the snow will prevent direct contact with soil.
Conversion Factor (CF)	0.000001	kg/mg	

Note: (ED), (BW) and (AT) are general parameters. Please refer to page 1 for their values.

Table F-7
Dermal Contact with Groundwater

Exposure Parameter	Value		Selection Rationale (Reference)
DERMAL CONTACT WITH GROUNDWATER (Bathing)**			
Absorbed Dose (mg/kg-day) = (Cw x SA x PC x ET x EF x ED x CF) / (BW x AT)			
Concentration in Water (Cw)	Varies	mg/L	Chemical-specific value.
Skin Surface Area (SA)			
Average			
Adult Residents	20000	cm^2	Aproximate mean value for adults (USEPA, 1992).
Child Residents	7280	cm^2	50th percentile total body SA for males 3-6 years (USEPA, 1989a).
Reasonable Maximum			
Adult Residents	20000	cm^2	Aproximate mean value for adults (USEPA, 1992).
Child Residents	7280	cm^2	50th percentile total body SA for males 3-6 years (USEPA, 1989a).
Permeability Constant (PC)	Varies	cm/hr	Chemical-specific value.
Exposure Time (ET)			
Average			
All Residents	0.12	hr/day	Median shower time; 7 min/day (USEPA, 1992).
Reasonable Maximum			
All Residents	0.17	hr/day	Recommended reasonable maximum value (USEPA Reg. X, 1991b).
Exposure Frequency (EF)			
Average			
All Residents	275	day/yr	On average, people spend 75% of their time at home. 75% of a full year equals 275 days/year (USEPA, 1991a).
Reasonable Maximum			
All Residents	350	day/yr	Default value (USEPA, 1991a).
Conversion Factor (CF)	0.001	L/cm^3	

** This pathway is only applicable if groundwater modeling shows Old Town Galena to be downgradient of any site.

Note: (ED), (BW) and (AT) are general parameters. Please refer to page 1 for their values.

Table F-8
Inhalation of Fugitive Dust / Vapors

Exposure Parameter	Value		Selection Rationale (Reference)
INHALATION OF FUGITIVE DUST/VAPORS			
Effective Air Concentration (mg/m^3) = (Ca x IRD x ET x EF x ED) / (IRE x AT)			
Concentration in Air (Ca)	Varies	mg/m^3	Chemical-specific value.
Breathing Rate During Exposure (IRD)			
Average			
Adult Residents	0.833	m^3/hr	Equivalent to adult rate, 20 m3/day (USEPA, 1991a).
Child Residents	0.5	m^3/hr	Default value for children (USEPA Region III, 1995).
Short Term Workers	0.833	m^3/hr	Equivalent to adult rate, 20 m3/day (USEPA, 1991a).
Long Term Workers	0.833	m^3/hr	Equivalent to adult rate, 20 m3/day (USEPA, 1991a).
Construction Workers	2.5	m^3/hr	Default value for workers (USEPA, 1991a).
Boarding Students	0.833	m^3/hr	Equivalent to adult rate, 20 m3/day (USEPA, 1991a).
Reasonable Maximum			
Adult Residents	0.833	m^3/hr	Equivalent to adult rate, 20 m3/day (USEPA, 1991a).
Child Residents	0.5	m^3/hr	Default value for children (USEPA Region III, 1994).
All Workers	2.5	m^3/hr	Default value for workers (USEPA, 1991a).
Boarding Students	0.833	m^3/hr	Equivalent to adult rate, 20 m3/day (USEPA, 1991a).
Exposure Time (ET)			
Average & Reasonable Maximum			
All Residents	24	hr/day	Indoor and ourdoor air assumed to be equivalent.
All Workers	8	hr/day	Default value (USEPA, 1991a).
Boarding Students	24	hr/day	Indoor and ourdoor air assumed to be equivalent.
Exposure Frequency (EF)			
Average			
All Residents	275	day/yr	On average, people spend 75% of their time at home. 75 percent of a full year equals 275 days/year (USEPA, 1991a).
All Workers	250	day/yr	Assumes a 5 day work week for 50 weeks (USEPA, 1991a).
Boarding Students	270	day/yr	Assumes students board for 270 days a year (9 months).
Reasonable Maximum			
All Residents	350	day/yr	Default value; 365 days/year minus 2 weeks vacation (USEPA, 1991a).
All Workers	250	day/yr	Assumes a 5 day work week for 50 weeks (USEPA, 1991a).
Boarding Students	270	day/yr	Assumes 270 school days a year (9 months).
Daily Breathing Rate (IRD)			
Average & Reasonable Maximum			
Adult Residents	20	m^3/day	Default value for adults (USEPA, 1991a).
Child Residents	12	m^3/day	Default value for children (USEPA Region III, 1995).
All Workers	20	m^3/day	Default value for adults (USEPA, 1991a).
Boarding Students	20	m^3/day	Default value for adults (USEPA, 1991a).

Note: (ED), (BW) and (AT) are general parameters. Please refer to page 1 for their values.

Table F-9
Inhalation of Vapors While Showering

Exposure Parameter	Value		Selection Rationale (Reference)
INHALATION OF VAPORS WHILE SHOWERING**			
Effective Air Concentration (mg/m^3) = (Ca x BRe x ET x EF x ED) / (BRd x AT)			
Concentration in Air (Ca)	Varies	mg/m^3	Chemical-specific value.
Breathing Rate During Exposure (BRe)			
Average & Reasonable Maximum			
All Residents	0.6	m^3/hr	Inhalation rate for all age groups while showering (USEPA, 1989b).
Exposure Time (ET)			
Average			
All Residents	0.12	hr/day	Median shower time; 7min/day (USEPA, 1992).
Reasonable Maximum			
All Residents	0.17	hr/day	Recommended reasonable maximum value (USEPA Region X, 1991b).
Exposure Frequency (EF)			
Average			
All Residents	275	day/yr	On average, people spend 75% of their time at home. 75 percent of a full year equals 275 days/year (USEPA, 1991a).
Reasonable Maximum			
All Residents	350	day/yr	Default value; 365 days/year minus 2 weeks vacation (USEPA, 1991a).
Daily Breathing Rate (BRd)			
Average & Reasonable Maximum			
Adult Residents	20	m^3/day	Default value for adults (USEPA, 1991a).
Child Residents	12	m^3/day	Default value for children (USEPA Region III, 1995).

**** This pathway is only applicable if groundwater modeling shows Old Town Galena to be downgradient of the base.**

Note: (ED), (BW) and (AT) are general parameters. Please refer to page 1 for their values.

References for Appendix F

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U.S. Environmental Protection Agency (USEPA), 1992 . *Dermal Exposure Assessment: Principles and Applications.* Interim Report. EPA/600/8-91/011B.

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APPENDIX G

Human Health Toxicity Profiles

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G.1 Acetone

In studies on occupationally exposed workers and laboratory volunteers, inhalation exposure to acetone concentrations of 900 ppm or greater has resulted in respiratory tract irritation. Eye irritation has also accompanied exposures in occupational and laboratory settings. In controlled studies, no adverse effects on liver or kidney function were detected in persons exposed to 500 ppm for 2 hours. Prolonged exposure to higher concentrations of acetone may result in neurological effects such as dizziness and fatigue. These are most likely due to the lipid solvent properties of acetone which may interfere with transmembrane ion transport (for review, see ATSDR, 1993). Acetone is readily absorbed orally by humans and can also be absorbed dermally. Regardless of the route of administration, the predominant route of excretion is in the expired air. Reliable data on possible teratogenic and carcinogenic effects of acetone in humans are not reported in the literature.

In a 90-day oral gavage study, albino rats received 2500, 500, or 100 mg/kg-day (American Biogenics, 1986). Body weights, food consumption, clinical chemistry, hematology, histopathology parameters, as well as organ weights and organ-to-body weight ratios, were measured. Liver weight and liver/body weight ratios were elevated in both sexes for the high dose group. There were statistically significantly increased kidney weights in females at 500 and 2500 mg/kg-day and increased kidney-to-body and brain weight ratios for males and females at 2500 mg/kg-day. Histopathologic examination revealed a marked increase of severity in tubular degeneration of the kidneys and hyaline droplet accumulation. A dose response was observed. No effects were seen in the 100 mg/kg-day group. The No Observable Adverse Effect Level (NOAEL) was 100 mg/kg-day and the Lowest Observable Adverse Effect Level (LOAEL) was 500 mg/kg-day due to the increased liver and kidney weights in conjunction with nephrotoxicity.

Other studies in animals demonstrated that acetone is not a developmental toxin. Phytotoxicity occurred only at doses that were also maternally toxic. Acetone has been used as the solvent in carcinogenicity studies with other compounds in animals; no excess tumor incidence was seen in the solvent control animals. This absence of carcinogenicity is consistent

with the generally negative results obtained with acetone in a variety of short term genotoxicity studies (ATSDR, 1993).

IRIS lists the chronic oral RfD as 1.0E-01 mg/kg-day based on the rat study described above (American Biogenics, 1986). An uncertainty factor of 1000 was used in the RfD calculation to account for inter- and intraspecies variation, and for the extrapolation from subchronic to chronic exposure. IRIS confidence in this study is medium since a moderate number of animals was used and an extensive number of clinical parameters were analyzed. IRIS confidence in the oral RfD is low since only a limited number of studies are available.

The HEAST subchronic oral RfD is 1.0E+00 mg/kg-day. Other exposure guidelines include a Threshold Limit Value of 750 ppm (8-hour time weighted average) (ACGIH, 1993-1994), an acute duration (i.e., 14 days or less) Minimum Risk Level of 0.4 ppm, and an intermediate duration (i.e., 15-364 days) Minimum Risk Level of 0.2 ppm (ATSDR, 1993). Inhalation RfCs were not available in IRIS or HEAST. EPA has designated acetone as a Group D carcinogen (Not Classifiable as a Human Carcinogen).

References

ACGIH (American College of Governmental Industrial Hygienists) (1993-1994) 1993-1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH, Cincinnati, Oh.

American Biogenics (1986) "Ninety Day Gavage Study in Albino Rats Using Acetone". American Biogenics Corp., Decatur, IL (unpublished study).

ATSDR (Agency for Toxic Substances and Disease Registry) (1993) Toxicological Profile for Acetone (Draft). U.S. Dept. of Health and Human Services, Atlanta, GA.

Revised/updated by VLR 09 December 1994
values checked 5/95
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G.2 Aldrin

Exposure to aldrin is not extensive because it breaks down very rapidly to dieldrin (a toxic lipid-soluble metabolite of aldrin stored in adipose tissue) in the environment. No increase in mortality from any cause has been reported in workers who have been employed in the manufacture of aldrin for more than four years. Information regarding the respiratory effects of aldrin in humans is limited and conflicting. One occupational exposure study indicates that workers demonstrate no new pulmonary disease or deterioration of existing pulmonary disease, although a similar study reported significantly increased incidences of pneumonia and other pulmonary diseases (ATSDR, *Toxicological Profile for Aldrin/Dieldrin*, 1991). Central nervous system excitation culminating in convulsions is the principal toxic effect noted in occupational studies of workers employed in the manufacture or application of aldrin. Short-term exposure to high levels of aldrin causes convulsions and kidney damage. Reproductive effects and liver effects have also been reported. The probable oral lethal dose for humans is between 7 drops and 1 ounce for a 150 lb. adult. Victims of acute exposure may have convulsions without warning. Aldrin can also burn the skin and eyes. Long-term exposures to lower levels of aldrin may also cause convulsions as a result of aldrin's potential to accumulate within the body. Long-term exposure to moderate levels of aldrin causes headaches, dizziness, irritability, vomiting, or uncontrollable muscle movements. A condition in which aldrin causes the body to destroy its own blood cells has been noted in some sensitive people.

The carcinogenic and reproductive/developmental effects of aldrin in humans are currently unknown. Experimental studies indicate that animals born to mothers that were fed aldrin do not live long. Conflicting results have been obtained in animal studies with regard to the teratogenic potential of aldrin as well as its effects on reproductive ability. One study revealed detectable levels of dieldrin could be found in the human placenta, amniotic fluid, and fetal blood. These results suggest that dieldrin can pass through the human placenta and accumulate in the developing fetus. A limited number of epidemiologic studies examining the

incidence of cancer in workers exposed to aldrin or dieldrin exist. No evidence of carcinogenic potential in humans was observed in these studies (ATSDR, *Toxicological Profile for Aldrin/Dieldrin*, 1991).

IRIS lists the chronic oral RfD for aldrin as 3.0E-05 mg/kg/day. This value was determined from a two-year chronic study of aldrin in rats. The experimental groups were orally dosed with 0, 0.5, 2, 10, 50, 100 or 150 ppm (in the diet) for two years. Liver lesions characteristic of chlorinated insecticide poisoning were observed at dose levels of 0.5ppm and greater. These lesions were characterized by enlarged centrilobular heptic cells, with increased cytoplasmic oxyphilia, and peripheral migration of basophilic granules. A statistically significant increase in liver-to-body weight ratio was observed at all dose levels. Kidney lesions occurred at the highest dose levels. Survival was markedly decreased at dose levels of 50 ppm and greater. A LOAEL (lowest observed adverse effect level) of 0.5 ppm was established in this study. A NOAEL (no observed adverse effect level) was not established. Additional data are fairly supportive of the findings from the critical study.

There is no inhalation RfD or RfC for aldrin. HEAST lists the subchronic oral RfD as 3.0E-05 mg/kg/day.

The uncertainty factor used to derive the RfD for aldrin is 1000. This factor encompasses the uncertainties of extrapolation from animals to humans, range of human sensitivities, basing the RfD on a LOAEL rather than a NOAEL. The confidence level for the RfD value is medium. The supporting study performed histopathologic analysis but lacked other toxicologic parameters. Confidence in the database was also medium.

Human carcinogenicity studies are inadequate, but animal carcinogenicity studies are sufficient to classify aldrin as Group B2 - Probable Human Carcinogen. The oral slope factor for aldrin is listed in IRIS as 1.7E+01 $(mg/kg/day)^{-1}$; and the inhalation unit risk is listed as 4.9E-03 $(\mu g/m^3)^{-1}$. After chronic ingestion of 10 ppm in the diet, a statistically significant increase in hepatomas in mice was observed. Most of these tumors were liver carcinomas. The study

treated an adequate number of animals for a large proportion of their lifetime and the route of treatment was appropriate. HEAST listed an inhalation slope factor of 1.70E+01 $(mg/kg/day)^{-1}$.

G.3 Aluminum

Despite the widespread occurrence of aluminum in food, drinking water, and soil, there is little indication that aluminum is toxic by ingestion unless it is present in high quantities. Aluminum compounds can affect absorption of other elements in the gastrointestinal tract and alter intestinal function, leading to a variety of complications. Other systemic toxicities can be caused by oral exposure to relatively high levels of aluminum. However, aluminum compounds are widely used in many ways including antiperspirants without harmful effects to the skin or other organs (ATSDR, *Toxicological Profile for Aluminum*, 1991).

Workers in the aluminum industry were shown to have an increased incidence of asthma, coughing, decreased pulmonary function, pulmonary fibrosis, and several types of cancer. However, aluminum cannot be definitively identified as the causal agent in these studies because of concurrent exposure to other toxic chemicals. In addition, smoking was not considered in the evaluation (ATSDR, *Toxicological Profile for Aluminum*, 1991).

No toxicity information is currently available on IRIS or HEAST.

A provisional chronic oral reference dose of 1.0 E+0 (mg/kg/day) was obtained from EPA Region III. (USEPA, 1995).

References

USEPA, 1995. United States Environmental Protection Agency Region III Risk-Based Concentration Table. EPA Region III, Philadelphia, Pennsylvania.

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G.4 Arsenic

Large oral doses (above 60,000 ppb in food or water) of inorganic arsenic can produce death in humans. Lower levels of inorganic arsenic (300-30,000 ppb in food or water) if swallowed may result in irritation of the stomach and intestines, with symptoms such as pain, nausea, vomiting, and diarrhea. Other effects associated with ingestion of arsenic include decreased production of red and white blood cells, abnormal heart function, blood-vessel damage, and impaired nerve function causing a "pins and needles" sensation in the hands and feet. Animal studies indicate that doses of arsenic large enough to cause illness in pregnant females, may cause low birth weight, fetal malformations, or death of the fetus. However, there is no evidence available that suggests that arsenic is teratogenic or fetotoxic (ATSDR, 1992).

Long-term oral exposure to inorganic arsenic often results in changes in the skin. The pattern of skin changes associated with arsenic exposure includes darkening of the skin and the appearance of "corns" or "warts" on the palms, soles, and torso. These skin changes are not considered to be a health concern. However, a small number of the corns may ultimately develop into skin cancer. Ingestion of arsenic has also been reported to increase the risk of cancer in the liver, bladder, kidney, and lung (ATSDR, 1992).

Inhalation of high levels of arsenic usually results in a sore throat and irritated lungs. Changes in skin patterns may also be experienced. The level at which these effects are likely to occur in humans is uncertain, but is probably above 100 $\mu g/m^3$. These effects usually are not serious, but inhaled inorganic arsenic has been reported to increase the risk of lung cancer. However, this has been observed primarily in people exposed to arsenic in or around smelters (ATSDR, 1992).

The oral RfD for arsenic is listed in IRIS as 3.0E-04 mg/kg/day. This value is supported by two studies using human populations exposed to arsenic in well water. The low dose group received 5-7 μg/L and the high dose group received 410 μg/L in well water. The exposure estimate for a high dose is 410 μg/L x 3 L/day x (1/55 kg) = 22 μg/kg-day and for a low dose is 5-7 μg/L x 3 L/day x (1/55 kg) = 0.3 - 0.4 μg/kg-day. The incidences of blackfoot disease, hyperpigmentation and keratosis increased with dose and age. Exposure times were directly related to chronological age in 75% of the cases. This study reported the NOAEL as 8.0E-04 mg/kg/day and

the LOAEL as 1.4E-02 mg/kg/day. The critical effect was hyperpigmentation, keratosis, and possible vascular complications. HEAST lists a value of 3.00E-04 mg/kg/day for the subchronic oral RfD.

The uncertainty factor used to derive the oral RfD was 3. This factor accounts for the lack of both general data and information regarding sensitive individuals. The confidence level is medium. An extremely large number of people (>40,000) was used in the assessment, but doses were not well characterized and other contaminants were present. The supporting human toxicity database is extensive but somewhat flawed. The database does support the choice of NOAEL, hence the confidence rating of medium. No inhalation RfD or RfC values are listed in IRIS or HEAST.

Arsenic is classified as Group A - Human Carcinogen. This classification is based on: 1) results of several epidemiologic studies in which increases in lung cancer mortality were observed among workers exposed to arsenic primarily through inhalation in the work place, and 2) reports of increased skin cancer incidence in several populations consuming drinking water with high arsenic concentrations.

An oral slope factor of 1.5E+0 $(mg/kg/day)^{-1}$ was derived based on the drinking water unit risk value (5.0E-5 µg/L) provided in IRIS (USEPA, 1995).

The inhalation unit risk is listed in IRIS as 4.3E-03 $(\mu g/m^3)^{-1}$. HEAST lists a value of 5.0E+01 $(mg/kg/day)^{-1}$ for the inhalation slope factor. A large population was observed and the exposure assessment included air measurements for the Anaconda smelter and both air measurements and urinary arsenic for the ASARCO smelter. Observed lung cancer incidence was significantly increased over expected values.

References

ATSDR, *Toxicological Profile for Arsenic*, 1992

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G.5 Barium

Most studies of the health effects of barium evaluate oral exposures. Acute ingestion of high levels of barium can result in respiratory weakness, abnormalities in heart rhythm, hypertension, gastrointestinal disturbances, progressive muscle weakness, and renal insufficiency. The occurrence and severity of symptoms decrease with decreasing dose levels. The only well documented adverse effect following low-level, chronic exposure is cardiovascular compromise. Significant increases in blood pressure were noted in rats administered 5.4 to 7.1 mg/kg/day for up to 16 months (ATSDR, 1991).

Studies of the inhalation toxicity of barium have only been documented in workers exposed to barium dust. Abdominal cramps, nausea, vomiting, pulmonary lesions, muscle weakness, and renal failure was observed in a factory worker accidentally exposed to high levels of barium carbonate powder. There are limited data on inhalation studies in laboratory animals to support any definitive conclusions (ATSDR, 1991).

IRIS lists the chronic Reference Dose for barium as 7.0E-02 mg/kg/day (IRIS, 1995). This is based primarily on two studies. In the first study, 11 healthy male volunteers received drinking water (1.5 L/day) containing 0 mg/L barium for weeks 0 to 2, 5 mg/L for weeks 3 to 6, and 10 mg/L for weeks 7 to 10 (Wones et al., 1990). There were no changes in blood pressure, serum chemistry, or cardiac function. The No-Adverse-Effect-Level was 10 mg/L, which corresponds to 0.21 mg/kg/day. The second study was a retrospective epidemiology study that compared human mortality and morbidity rates in populations ingesting 2 to 10 mg/L barium in drinking water (corresponding roughly to a dose of 0.2 mg/kg/day) to populations ingesting 0 to 0.2 mg/L (Brenniman and Levy, 1984). No definitive differences could be attributed to the elevated barium levels. An uncertainty factor of 3 was used since data are available from a chronic human study. The level of confidence in the RfD is medium.

HEAST lists a subchronic oral Reference Dose of 7.0E-02 mg/kg/day (HEAST, 1994). Although not listed in IRIS, inhalation Reference Concentrations are available in HEAST

as 5.0E-04 mg/m^3 (chronic) and 5.0E-03 mg/m^3 (subchronic). These values are based on an inhalation study in which rats were exposed to 0.80 mg/m^3 barium for 4 hours/day for 4 months. Fetotoxic effects were reported as a result of exposure. An uncertainty factor of 1000 was applied to account for inter- and intra-species variation and for extrapolating from a subchronic to a chronic study (10X each). The Threshold Limit Value for barium soluble salts is 0.5 mg/m^3 (8-hour time weighted average, as barium) (ACGIH, 1993-1994). Barium has not been evaluated for carcinogenicity by the U.S. EPA.

References

ACGIH (American Conference of Governmental Industrial Hygienists) (1993-1994) 1993-1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH, Cincinnati, OH.

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Revised/updated by VLR 13 December 1994
values checked 5/95
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G.6 Benzene

Benzene is a colorless liquid with a sweet odor. It is volatile, soluble in water, and very flammable. Benzene occurs naturally and is produced by man. It is used in industry to produce other chemicals, and to manufacture some types of rubber, lubricants, dyes, detergents, and pesticides. Industrial processes are the main source of benzene in the environment. Benzene in water and soil may evaporate into the air where it is degraded in a few days. Benzene remaining in soil and water may also degrade in those media, or may migrate into groundwater (ATSDR, 1992).

Most people are exposed to a small amount of benzene on a daily basis. The major sources of benzene exposure are gasoline, automobile exhaust, industrial emissions, and tobacco smoke. Brief exposure (5-10 min) to very high levels of benzene in air (10,000-20,000 ppm) can result in death. Exposure to lower levels (700-3,000 ppm) may cause drowsiness, dizziness, headaches, and unconsciousness. These effects usually disappear once exposure is interrupted. Ingestion of foods or beverages containing high levels of benzene may result in vomiting, dizziness, convulsions, and death. Human health effects associated with ingestion of lower levels of benzene are currently unknown. Dermal contact with benzene may cause redness or blisters (ATSDR, 1992).

The majority of information on the effect of long-term exposure to benzene is from studies involving occupational exposure of employees to ambient levels of benzene far greater than the levels normally encountered by the general population. Inhalation of benzene for long periods of time may cause adverse effects in the tissues that form blood cells, especially the bone marrow. This may result in disruption of normal blood production and cause a decrease in important blood components, leading to anemia or excessive bleeding. Blood production may return to normal upon disruption of exposure. Benzene exposure can be harmful to the immune system, enhancing the probability of infection and perhaps lowering the body's defense against tumors. Long-term exposure to benzene in the air causes leukemia and has been associated with genetic changes (ATSDR, 1992).

Long-term exposure to benzene may also damage the reproductive organs. Some female workers who breathed high levels of benzene for many months experienced irregular menstrual cycles. Upon examination of these women, decreased ovary size was revealed. However, exposure levels were not documented and it was not proven that benzene was responsible for the effects. Currently it is not known what effects benzene exposure has on the developing fetus in pregnant women. Studies in which pregnant laboratory animals were exposed to benzene resulted in low birth weights, delayed bone formation, and bone marrow damage (ATSDR, 1992).

Human health effects associated with long-term exposure to food and water contaminated with benzene are not known. Animal studies indicate that oral exposure can damage the blood and immune system. Oral exposure of experimental animals to benzene has also been linked to cancer (ATSDR, 1992).

Although no oral RfD has been established, EPA Region III provides an inhalation RfD of 1.7 E-3 mg/kg/day. This value was converted to a Reference Concentration (RfC) of 6.0 E-3 mg/m^3 using an inhalation rate of 20 m^3/day and a body weight of 70 kg.

EPA classifies benzene as Group A - Human Carcinogen. This classification is based on numerous epidemiologic studies which demonstrated an increased incidence or causal relationship between leukemia and occupational exposure to benzene. Supporting data include an increased incidence of neoplasia in rats and mice exposed by inhalation and gavage and an increase in chromosomal aberrations of bone marrow cells and peripheral lymphocytes from occupational exposure. IRIS lists an oral slope factor of 2.9E-02 (mg/kg/day)$^{-1}$ and an inhalation unit risk of 8.3E-06 (μg/m3)$^{-1}$ has been derived from human data for inhalation exposure. HEAST lists an inhalation slope factor for benzene as 2.9E-2 (mg/kg/day)$^{-1}$.

References

ATSDR (Agency for Toxic Substances and Disease Registry). (1992). Draft Toxicological Profile for Benzene. U.S. Dept. of Health and Human Services. Atlanta, GA.

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G.7 Benzoic Acid

IRIS lists the chronic oral RfD for benzoic acid as 4.0E+00 mg/kg-day which is the same value as the subchronic oral RfD listed in HEAST. Benzoic acid and sodium benzoate are common food preservatives and are Generally Recognized as Safe (GRAS) by the FDA. Therefore, the NOAEL was derived by estimating the upper range of daily benzoic acid intake per person. Medium confidence has been assigned to this value since it is based on adequate human data.

Benzoic acid is a Group D Carcinogen -- Not Classifiable as to Human Carcinogenicity. In a lifetime study, 100 mice were given benzoic acid at a level of 2% in drinking water. At the end of the study, histological examination was performed and it was concluded that the treatment had no apparent effect on survival or tumor incidence.

G.8 Beryllium

Various health effects related to beryllium exposure have been documented in human and animal investigations. Contact dermatitis is the most common beryllium-related toxic effect. Exposure to soluble beryllium compounds may result in papulovesicular lesions on the skin. It is a delayed-type hypersensitivity reaction. Acute chemical pneumonitis may result from inhalation of beryllium and occurs almost immediately following inhalation of aerosols of soluble beryllium compounds, particularly the fluoride. Severity is dose-related and lethality has been reported. Chronic granulomatous pulmonary disease (berylliosis) may develop after exposure to insoluble beryllium compounds, particularly beryllium oxide. The major symptoms are shortness of breath and, in severe cases, cyanosis and clubbing of fingers. *In vitro* studies of genotoxicity have shown that beryllium will induce morphologic transformation in mammalian cells. It will also decrease fidelity of DNA synthesis, but is negative when tested as a mutagen in bacterial systems.

The oral RfD for beryllium is listed in IRIS as 5.0E-03 mg/kg/day (IRIS, 1995). The NOAEL is listed as 5 ppm (0.54 mg/kg of body weight/day) in drinking water. The RfD value is based on a lifetime study of 52 weanling rats which received 0 or 5 ppm beryllium (as beryllium sulfate) in drinking water. At natural death, the rats were dissected and gross and microscopic changes were noted in the heart, kidney, liver, and spleen. There were no effects of treatment on these organs or on lifespan, urinalysis, serum glucose, cholesterol, and uric acid, or on numbers of tumors. Male rats experienced decreased growth rates from 2 to 6 months of age. In a similar study, doses of 0.95 mg/kg/day caused decreased body weights in female mice. Male mice exhibited slight increases in body weight. HEAST lists a value of 5.0E-03 mg/kg/day for the subchronic oral RfD (HEAST, 1994).

The uncertainty factor applied to derivation of the oral RfD is 100. This factor accounts for interspecies (10X) conversion and for protection of sensitive human subpopulations (10X). The confidence level is low because only one dose level was administered. Although numerous inhalation investigations and a supporting chronic oral bioassay in mice exist, along with work that indicates a higher dose level may be a NOEL, these studies are considered low to medium in quality. Therefore, the database is given a confidence level of low.

Beryllium is classified as Group B2 - Probable Human Carcinogen. This classification is based on its ability to induce lung cancer via inhalation in rats and monkeys and to induce osteosarcomas in rabbits via intravenous or intramedullary injection. Human epidemiology studies are considered to be inadequate. The oral slope factor is listed in IRIS as 4.3+00 $(mg/kg/day)^{-1}$, the inhalation unit risk value as 2.4E-03 $(\mu g/m^3)^{-1}$, and the inhalation slope factor as 8.4E+00 $(mg/kg/day)^{-1}$. The estimate for the oral slope factor is derived from a study which did not show a significant increase in tumorigenic response. While this study is limited by use of only one non-zero dose group and the occurrence of high mortality and unspecified time and site of the tumors, it was used as the basis of the quantitative estimate because exposure occurred via the most relevant route.

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G.9 BHC (Alpha, Beta, Delta, Gamma)

Benzene hexachloride (BHC), also known as hexachlorocyclohexane (HCH), exists in eight chemical forms (isomers). The most studied isomer is gamma-BHC. People generally are not exposed to the alpha-, beta-, or delta-forms of BHC separately but to lindane (gamma-BHC) or to technical-grade BHC (a mixture of the alpha-, beta-,delta-, and gamma-forms). Therefore, the health effects of the BHC isomers are considered jointly. The adverse health effects of lindane and the other BHC isomers (alpha, beta, and delta) that have been seen in humans include lung irritation, heart disorders, blood disorders, headache, convulsions, and

alterations in levels of sex hormones. These effects were observed in individuals exposed to BHC vapors during its manufacture and/or in individuals accidentally exposed to very large quantities of BHC. Death can result in humans and animals exposed to large amounts of BHC. Liver disease has been reported in animals fed lindane or alpha-, beta-, or technical-grade BHC and liver cancer has been reported in rodents which received long-term administration of these compounds (ATSDR, 1989).

Alpha-BHC

There are no oral or inhalation RfD or RfC values listed in IRIS or HEAST for alpha-BHC. Little information is available on the health effects of alpha-BHC.

Alpha-BHC is listed in IRIS as class B2 - Probable Human Carcinogen. This classification is supported by an increased incidence of liver tumors in mice and rats when given dietary alpha-BHC. Human carcinogenicity data is inadequate. The oral slope factor is listed in IRIS as 6.3E+00 mg/kg/day and the inhalation slope factor as 1.8E-03 (μg/m^3. In the study used to derive the oral slope factor, relatively few animals were treated, and the treatment time was not considered adequate for the development of spontaneous tumors. HEAST lists a value of 6.3E+00 (mg/kg/day)$^{-1}$ for the inhalation slope factor.

Beta-BHC

There are no oral or inhalation RfD or RfC values listed in IRIS or HEAST for beta-BHC. Little information is available on the health effects of beta-BHC.

Beta-BHC is listed as Class C - Possible Human Carcinogen. This classification is supported by an increase in benign liver tumors when mice were exposed to beta-BHC in the diet. The oral slope factor is listed in IRIS as 1.8E+00 (mg/kg/day)$^{-1}$ and the inhalation slope factor is listed in HEAST as 1.8E+00 (mg/kg/day)$^{-1}$. IRIS lists an inhalation unit risk of 5.3E-04 (μg/m^3)$^{-1}$.

Gamma-BHC (Lindane)

The oral RfD for gamma-BHC is listed in IRIS as 3.0E-04 mg/kg/day. This value is supported by a 12-week study in which rats were dosed with 0, 0.2, 0.8, 4, 20, or 100ppm gamma-BHC in the diet. After 12 weeks, 15 animals/sex/group were sacrificed. The remaining rats were fed the control diet for an additional six weeks before sacrifice. Treatment related effects were noted in mortality, hematology, clinical chemistry, and urinalysis. Rats receiving 20 and 100ppm gamma-BHC were observed to have greater incidence of the following than the control rats: liver hypertrophy, kidney tubular degeneration, hyaline droplets, tubular distension, interstitial nephritis, and basophilic tubules. Because these effects were mild or rare in animals receiving 4 ppm, this value represents a NOAEL. The reviewers of the study calculated the dose to be 0.29 mg/kg/day for males and 0.33 mg/kg/day for females based on measured food intake. A LOAEL of 20 ppm (converted to 1.55 mg/kg/day for males) was also established.

An uncertainty factor of 1000 was used to determine the RfD for gamma-BHC. A factor of 10 each was employed for use of a subchronic assay, to account for interspecies variation and to protect sensitive human subpopulations. A confidence rating of medium is associated with the RfD for gamma-BHC. This rating reflects that the principal study used an adequate number of animals and measured multiple endpoints.

IRIS does not list an inhalation RfC for Gamma-BHC at this time. A risk assessment for the development of an inhalation RfC is under review for this agent. HEAST lists the subchronic oral RfD as 3.0E-03 mg/kg/day.

Gamma-BHC is classified as a Group B2/C - Probable Human Carcinogen/Possible Human Carcinogen. HEAST lists the oral slope factor as 1.3E+00 $(mg/kg/day)^{-1}$, but this value is currently under review. No inhalation unit risk was given.

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G.10 Bis(2-ethylhexyl)Phthalate

Most information about the health effects of bis(2-ethylhexyl)phthalate (BEHP) has been obtained from animal studies conducted on rodents. BEHP appears to affect rodents differently than humans, making human health effects difficult to predict. Studies in rats indicate that BEHP in the air has no effect on lifespan or the ability to reproduce and, therefore, breathing BEHP does not appear to have serious harmful effects. Adverse health effects resulting from dermal contact with BEHP are not expected because it is not easily absorbed through the skin (ATSDR, 1992).

Oral short-term and chronic exposure to BEHP results in reproductive toxicity. No studies on the reproductive effects of BEHP on humans were available. BEHP resulted in deleterious effects on the development of the fetus (low birth weights and skeletal and/or nervous system problems) when pregnant rodents were exposed. Therefore, it is possible that exposure of pregnant women to BEHP could result in similar effects, but this is not certain. Long-term exposure of animals to BEHP results in structural and functional changes in the kidney (ATSDR, 1992).

There have been no studies of workers exposed to BEHP that indicate it causes cancer in humans. Ingestion of high doses of BEHP for long periods of time resulted in liver cancer in rats and mice. However, there is disagreement as to whether exposure to BEHP increases the risk of humans developing cancer because BEHP causes less damage to human livers than rodent livers (ATSDR, 1992).

An oral RfD of 2.0E-02 mg/kg/day is listed in IRIS for bis(2-ethylhexyl)phthalate based primarily on a subchronic-to-chronic oral bioassay conducted in guinea pigs. Guinea pigs were fed diets containing BEHP for a period of one year. Males and females consumed feed containing 0.13%, 0.04%, or control diet. These dietary levels correspond to 64 or 19 mg/kg/day based on measured food consumption. The critical effect observed in this study was increased relative liver weight in females at both doses tested (64 and 19 mg/kg/day). No treatment-related effects were seen on mortality, body weight, kidney weight, or gross pathology and histopathology of kidney, liver, lung, spleen, or testes. A NOAEL was not established in the study but a LOAEL of 19 mg/kg/day was established.

An uncertainty factor of 1000 was used. Factors of 10 each were used to account for interspecies variation and protection of sensitive human subpopulations. An additional factor of 10 was used to account for the less than lifetime exposure and because, while the RfD was determined from a LOAEL, the effect observed was considered to be minimally adverse. A confidence rating higher than medium for the RfD was precluded by the fact that only two doses of BEHP were used.

USEPA classifies BEHP as a Group B2 - Probable Human Carcinogen. This is based on animal carcinogenicity data in which rats and mice fed diets containing BEHP demonstrated an increased incidence of hepatocellular carcinomas and combined incidence of carcinomas and adenomas in female rats and both sexes of mice. Data from a mortality study conducted on BEHP production workers exposed to unknown concentrations was considered inadequate for assessing the human carcinogenic potential. The oral slope factor for BEHP is 1.4E-02 $(mg/kg/day)^{-1}$ and was obtained from IRIS. A provisional inhalation unit risk value of 4.0E-6 $(\mu g/m^3)^{-1}$ was provided by The Superfund Health Risk Technical Support Center (USEPA, 1994). A great deal of uncertainty surrounds this value since it was derived from the oral slope factor.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1992) Toxicological Profile for Di(2-Ethyl-hexyl)Phthalate U.S. Dept. of Health and Human Services, Atlanta, GA.

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G.11 Bromochloromethane

Bromochloromethane is a colorless to pale yellow, nonflammable liquid with a chloroform-like odor. This chemical is used primarily as a liquid fire-extinguishing agent and is also known as chlorobromomethane, CBM, or as Halon 1011 (a registered fire-extinguishing agent).

Narcosis was observed in rats exposed to 3000 ppm bromochloromethane in air for 15 minutes. Other acute inhalation studies with rats resulted in pulmonary edema (excess fluid in the lungs) below 22,000 ppm, with pneumonia and delayed death resulting from exposures above 22,000 ppm (ACGIH, 1991).

Subchronic animal studies reported no deaths from inhalation exposure to 1000 ppm bromochloromethane in air for 7 hours/day, 5 days/week, for a 14 week period.

Chronic inhalation studies using animals concluded that this chemical causes a rather prolonged anesthesia at high concentrations and has only a slight capacity to produce injury to the liver, which is reversible. The no effect level was observed to be 370 ppm (ACGIH, 1991).

There is no chronic exposure information for humans. Acute poisoning in firefighters exposed to very high levels (not quantified) of bromochloromethane vapors has been

reported in the literature. These cases were characterized by severe headache, loss of consciousness after exposure, loss in weight, gastric upsets, and slow recovery (ACGIH, 1991).

Based on the animal data evaluated, the occupational standard established for bromochlormethane is 200 ppm in air and is based on an 8-hour workday and 40-hour work week (ACGIH, 1994-1995).

At this time EPA has not provided carcinogenic or noncarcinogenic toxicity information for bromochloromethane. Currently, bromochloromethane is not considered carcinogenic by EPA (weight-of-evidence classification D -- not classifiable as to human carcinogenicity). However, EPA has stated that bromochloromethane consistently tests positive for mutagenicity in several microorganisms (IRIS, 1995).

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IRIS, 1995. Integrated Risk Information System (IRIS) Database. Fourth quarter update, 1995.

G.12 Chlorobenzene

Workers exposed to chlorobenzene have exhibited headaches, numbness, sleepiness, nausea, and vomiting. The ability to attribute these workers' symptoms to chlorobenzene alone is difficult, as the workers may have been exposed to other chemicals at the same time. In animals, chlorobenzene neurological, hepatic, and renal effects. Unconsciousness, tremors and restlessness have been observed, along with hepatic and renal necrosis and renal tubular degeneration. (ATSDR, 1990).

IRIS lists the oral RfD for chlorobenzene as 2.0E-02 mg/kg-day. This is based on a 13-week oral exposure study in dogs. The NOAEL was reported as 27.25 mg/kg-day and the

LOAEL was reported as 54.5 mg/kg-day. At the LOAEL, the dogs exhibited slight bile duct proliferation, cytologic alterations, and leukocytic infiltration of the stroma, all in liver. At a dose of 272.5 mg/kg-day death, weight loss, changes in hematology, clinical chemistry, and urine analysis and pathologic changes in liver, kidney, gastrointestinal mucosa, and hematopoietic tissue were observed. Confidence in the RfD is medium due to the fact that a NOAEL and a LOAEL were identified, along with several biochemical and biological endpoints. HEAST list the subchronic oral RfD as 2.0E-01 mg/kg-day. HEAST lists 2.0E-02 mg/m^3 as the chronic inhalation RfC.

Chlorobenzene is classified as a Group D - Not Classifiable as to Human Carcinogenicity. This is based on a lack of human and animal data and predominantly negative genetic toxicity data in bacterial, yeast, and mouse lymphoma cells.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1990) Draft Toxicological Profile for Chlorobenzene. U.S. Dept. of Health and Human Services, Atlanta, GA.

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G.13 Chlorodibenzodioxins (CDDs)

Because chlorodibenzodioxins (CDDs) almost invariably occur in mixtures, their toxicity is summarized here together. CDDs are a class of compounds with one to eight chlorine atoms on a parent dibenzodioxin. If all possible chlorination patterns are considered, there are 75 possible CDD congeners. Human exposure to CDDs usually involves concomitant exposure to other chemicals. Thus, the toxicity evaluation of CDDs has some uncertainty. Nevertheless, broad conclusions on their toxicity in humans can be reached.

Toxicity of CDDs. 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) is the most toxic CDD congener known. Although species sensitivity varies widely, TCDD is highly toxic in

all animals tested. The major toxic effects of TCDD in mammals are weight loss (wasting syndrome), hepatotoxicity, immunotoxicity, and chloracne. Reproductive and developmental effects have also been seen. TCDD doses that produced various effects in animals are: for death, LD50s ranged from 0.6 μg/kg in guinea pigs (Schwetz et al., 1973) to 5500 μg/kg in hamsters (Henck et al., 1981); for wasting syndrome in guinea pigs, the Lowest-Observed-Effect-Level was 4.86 ng/kg in a 90-day study (DeCaprio et al., 1986); for hepatotoxicity in guinea pigs, the Lowest-Observed-Effect-Level was 4.86 ng/kg (DeCaprio et al., 1986); for immunotoxic effects, the Lowest-Observed-Effect-Level was 40 ng/kg in guinea pigs (Vos et al., 1973). Reproductive and teratogenic effects were seen at doses ranging from 125 ng/kg/day (terata in rats; Sparschu et al., 1971a,b) to 1.5 ng/kg/day (reproductive and embryotoxicity in monkeys in a seven month dietary study; Allen et al., 1979; Schantz et al., 1979). TCDD was carcinogenic in rats and mice in chronic bioassays (NTP, 1982a,b).

In humans, chloracne is the only adverse effect that is definitively linked to TCDD exposure. Chloracne is a systemic toxicity and is not produced solely by dermal exposure. The minimum dose for chloracne in humans was estimated to be 0.1 μg/kg (Stevens, 1981). Limited data provide suggestive evidence in humans of hepatic effects, immunological disorders, reproductive and developmental toxicity, and carcinogenicity (ATSDR, 1989). The TCDD half-life in humans is approximately 6-7 years (Poiger and Schlatter, 1986; CDC, 1987).

Chronic and subchronic oral reference doses (RfD) are not available for TCDD.

Although HEAST provides cancer potency values for TCDD, these values are under review by EPA subject to change. The oral slope factor and inhalation unit risk provided in HEAST are 1.5E+5 $(mg/kg/day)^{-1}$ and 3.3E-8 $(\mu g/m^3)^{-1}$, respectively (HEAST, 1994).

In order to assign toxicity values to other CDDs, EPA suggests using Toxicity Equivalence Factors (TEF) (USEPA, 1994). The TEF approach is based on the assumption that TCDD is the most potent CDD, and that all other CDDs are less potent than TCDD. When assigning TEFs, TCDD is arbitrarily assigned a value of one, and the other CDDs are given TEFs

equal to a fraction of one based on their relative potency to TCDD. For example, 2,3,4,7,8-PentaCDD is approximately one-half as toxic as TCDD, and has a TEF of 0.5.

Using the TEF approach to derive the oral slope factor (SF_o) for PentaCDD is accomplished by multiplying the oral slope factor of TCDD by the TEF for PentaCDD. Numerically, the oral slope factor for PentaCDD is:

$$\begin{aligned} SF_o\ \text{PentaCDD} &= (SF_o\ \text{of TCDD}) \times (\text{TEF for PentaCDD}) \\ &= 1.5E{+}5\ (\text{mg/kg/day})^{-1} \times (0.5) \\ &= 7.5E{+}4\ (\text{mg/kg/day})^{-1} \end{aligned}$$

Heptachlorodibenzo-p-Dioxin (HpCDD)

In the absence of chemical-specific toxicity information, the TEF approach was used to derive toxicity values for HpCDD. The TEF assigned to HpCDD, based on its relative potency to TCDD, is 0.01 (USEPA, 1994).

Noncancer toxicity values are not available for HpCDD.

The oral slope factor for HpCDD was calculated as 1.5E+3 $(\text{mg/kg/day})^{-1}$. The inhalation unit risk was also calculated using the TEF approach and is 3.3E-3 $(\mu g/m^3)^{-1}$.

Octachlorodibenzo-p-Dioxin (OCDD)

In the absence of chemical-specific toxicity information from HEAST or IRIS, the TEF approach, described above, was used to derive carcinogenic toxicity values for OCDD. Based on its relative potency to TCDD, the TEF for OCDD is 0.001 (USEPA, 1994).

Noncancer toxicity values are not available for OCDD.

The oral slope factor and inhalation unit risk for OCDD were calculated as 1.5E+2 $(mg/kg/day)^{-1}$ and 3.3E-2 $(\mu g/m^3)^{-1}$, respectively.

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G.14 Chloroform

Chloroform is a colorless liquid with a pleasant odor and a sweet taste. Most chloroform reaches the environment as a result of industrial processes or the chlorination of water. Chloroform is also used in the production of other chemicals. Factories that use or produce chloroform may release it directly into the air. It may reach water and soil in waste water or as a result of spills. Chloroform in water and soil will evaporate quickly, so most chloroform in the environment will be in air (ATSDR, 1992).

Chloroform affects the central nervous system (CNS), liver, and kidneys following inhalation or ingestion of contaminated sources by humans. Inhalation of 900 ppm chloroform for a short period of time causes fatigue, dizziness, and headache. Short-term exposure to higher levels (8,000-10,000 ppm) may result in loss of consciousness and/or death. Long-term exposure to small amounts of chloroform in air, water, or food may cause kidney and liver damage. Dermal contact with chloroform can cause sores to develop on the skin (ATSDR, 1992).

Currently it is not known whether chloroform causes reproductive or developmental effects. The Department of Health and Human Services has ruled that chloroform may be a carcinogen. Epidemiologic studies indicate that a possible link exists between chloroform in chlorinated drinking water and the occurrence of cancer of the colon and urinary bladder (ATSDR, 1992).

Similar to the effects seen in humans, chloroform causes adverse effects on the CNS, liver, and kidneys of laboratory animals. One study indicated that rabbits exhibited kidney damage following 24-hrs of continuous skin contact. Abortions have been reported to occur in rats and mice exposed to smaller amounts of chloroform by either inhalation or ingestion during pregnancy. Birth defects occurred in the offspring of rodents subjected to chloroform contaminated air during pregnancy. Abnormal sperm have also been observed in mice exposed to small amounts of chloroform on a short-term basis. Furthermore, liver and kidney cancer developed in rodents chronically exposed to small amounts of chloroform in the diet. It is currently unknown whether cancer of the liver or kidney would develop in humans following long-term exposure to chloroform in drinking water (ATSDR, 1992).

IRIS lists a chronic oral RfD of 1.0E-02 mg/kg-day for chloroform. This is based on a chronic bioassay in which dogs were administered chloroform in a toothpaste base in gelatin capsules for 7.5 years. Experimental groups received 15 to 30 mg/kg-day, 6 days/week. Fatty cysts were observed in livers of some dogs. In addition, nodules of altered hepatocytes and dose-related increases in serum enzyme levels were also noted in high dose animals. A NOAEL (No

Observed Adverse Effect Level) was not established. The LOAEL (Lowest Observed Adverse Effect Level) of 15 mg/kg-day was converted to 12.9 mg/kg-day since exposures were for 6 days/week. HEAST lists the subchronic oral RfD for chloroform as 1.0E-02 mg/kg-day.

An uncertainty factor of 1000 was used (10x for use of LOAEL, 10x for interspecies conversion and 10x for protection of sensitive human populations). The level of confidence in the oral RfD is medium, reflecting that the critical study was of chronic duration and used a fairly large number of dogs. However, only two doses were used and no NOAEL was determined.

EPA classifies chloroform as Group B2 -- Probable Human Carcinogen. This classification is based on an increased incidence of several tumor types in rats and three strains of mice. Human carcinogenicity data were considered inadequate for use in risk assessment because there are no epidemiologic studies with exposure to pure chloroform. IRIS lists an oral slope factor of 6.1E-03 $(mg/kg\text{-}day)^{-1}$. The inhalation slope factor is 8.1E-02 $(mg/kg\text{-}day)^{-1}$ which is given in HEAST. The inhalation unit risk value given in IRIS is 2.30E-05 $(\mu g/m^3)^{-1}$.

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G.15 Chloromethane

Chloromethane is a clear, colorless gas with a faintly sweet, nonirritating odor. It is a naturally occurring chemical, but is also produced by industry. It was widely used as a coolant refrigerators, but its main use now is during the industrial production of other compounds. Chloromethane is present in ambient air, waters and soils in low concentrations

because of its production in nature. Higher levels may be found in these media due to industrial or waste release (ATSDR, 1990).

Chloromethane exposure may occur through inhalation, ingestion, and dermal contact. Inhalation is the most likely route of exposure. Deaths have been reported in humans and animals exposed to high concentration of chloromethane by inhalation. The concentrations and durations of exposure in these cases are unknown due to lack of reliable data. In both humans and animals, the neurological effects caused by chloromethane inhalation are the cause of its lethality. These neurological effects include fatigue, drowsiness, staggering, headache, blurred and double vision, confusion, tremors, vertigo, muscle cramps and rigidity, sleep disturbances, ataxia, convulsions and coma. Hepatic and renal adverse effects have also been observed in humans and animals with chloromethane inhalation. Respiratory, cardiovascular, gastrointestinal, and ocular effects are probably secondary to neurological effects. Inhalation of chloromethane has resulted in hematological, immunological, developmental, and reproductive adverse effects in animals. It has also been found to be genotoxic and carcinogenic in animals after inhalation (ATSDR, 1990).

There is little data available on the effects of chloromethane ingestion. Only one study was found with regards to the effects of orally administered chloromethane in rats. Only the livers were examined in this study, and no effects were found (ATSDR, 1990).

There is little data available on the effects of dermal exposure to chloromethane. The one study found in which exposure to chloromethane vapors in mice was reported to cause mucopurulent conjunctivitis with destruction of the eye in some cases is questionable, as the results have not been reproducible (ATSDR, 1990).

IRIS states that the oral RfD and inhalation RfD and RfC are currently under review by an EPA work group. HEAST does not list an interim RfD for chloromethane.

HEAST lists an oral slope factor of 1.3E-02 $(mg/kg\text{-}day)^{-1}$ and an inhalation slope factor of 6.3E-3 $(mg/kg\text{-}day)^{-1}$. These values are based on a 24-month inhalation study in mice in which kidney tumors were seen.

References

ATSDR, (Agency for Toxic Substances and Disease Registry) (1990) . Draft Toxicological Profile for Chloromethane. U.S. Dept. of Health and Human Services, Atlanta, GA.

U.S. EPA, (May 1994) Drinking Water Regulations and Health Advisories. EPA 822-R-94-001, U.S. Environmental Protection Agency, Office of Water.

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G.16 Cresols (2-, 3-, and 4-Methyl phenol)

Cresol, or Methyl phenol, exists as three chemical forms; *ortho*-cresol (*o*-cresol), *meta*-cresol (*m*-cresol), and *para*-cresol (*p*-cresol). Pure cresols are colorless chemicals, but are likely to be found most often in brown mixtures such as creosote and cresylic acids. Cresols can exist as solids or liquids and have a medicinal smell when dissolved in water. Cresols both occur naturally in the environment and are produced by humans (ATSDR, 1991).

Like phenol, chronic exposures to cresols have been reported to result in a broad spectrum of toxic effects in laboratory animals. In rats, the primary target organs affected by ortho- and meta-cresol are the nervous system (neurotoxicity) and the whole body (decreased weight gain). Similarly, in rabbits para-cresol affects the central nervous system (hypoactivity), respiratory system (distress) and whole body (maternal death) (HEAST, 1994).

The toxicity information for *o*-, *m*-, and *p*-cresol is discussed below separately for each chemical form.

o-Cresol

A chronic oral RfD of 5.0 E-2 mg/kg/day is provided in IRIS (IRIS, 1995). This value is based on the NOAEL from a subchronic 90 day oral feeding study with rats. The NOAEL from this study was 50 mg/kg/day. EPA rates the confidence in the RfD at medium since the study from which the NOAEL was determined was subchronic.

HEAST lists a subchronic oral RfD of 5.0 E-1 mg/kg/day for this chemical (HEAST, 1994).

Currently, EPA has determined that the inhalation data are inadequate to determine inhalation reference doses (RfD) or reference concentrations (RfC).

o-Cresol is classified by EPA as a Group C - Possible Human Carcinogen. This cancer classification is based on limited studies in which mice developed skin cancer when cresols were applied to their skin. Neither IRIS or HEAST provide any cancer potency values for this chemical.

m-Cresol

A chronic oral RfD of 5.0 E-2 mg/kg/day is provided in (IRIS, 1995). This value is based on the NOAEL from a subchronic 90 day oral feeding study with rats. The NOAEL from this study was 50 mg/kg/day. EPA rates the confidence in the RfD at medium since the study from which the NOAEL was determined was subchronic.

HEAST lists a subchronic oral RfD of 5.0 E-1 mg/kg/day for this chemical (HEAST, 1994).

Currently, EPA has determined that the inhalation data are inadequate to determine inhalation reference doses (RfD) or reference concentrations (RfC).

m-Cresol is classified by EPA as a Group C - Possible Human Carcinogen. This cancer classification is based on limited studies in which mice developed skin cancer when cresols were applied to their skin. Neither IRIS or HEAST provide any cancer potency values for this chemical.

p-Cresol

A chronic and subchronic oral RfD of 5.0 E-3 mg/kg/day is provided in HEAST for p-cresol (HEAST, 1994). This value is based on a subchronic oral feeding study with rabbits (gestation days 6 to 18). The uncertainty factor used to derive these RfDs was 1000.

Currently, EPA has determined that the inhalation data are inadequate to determine inhalation reference doses (RfD) or reference concentrations (RfC).

p-Cresol is classified by EPA as a Group C - Possible Human Carcinogen. Neither IRIS or HEAST provide any cancer potency values for this chemical.

References

ATSDR (Agency for Toxic Substances Disease Registry) 1991. Toxicological profile for Cresols.

HEAST (Health Effects Assessment Summary Tables) 1994.

IRIS (Integrated Risk Information System) 1995.

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G.17 Ethylbenzene

Little information on the human health effects of long-term exposure to ethylbenzene was found in the available literature. Low levels of ethylbenzene in the air cause irritation of the eyes and throat. Upon exposure to higher levels, persons demonstrate signs of

more severe effects such as decreased movement and dizziness. Short-term exposure to high levels of ethylbenzene in air may cause liver and kidney damage, nervous system changes, and changes in the blood of laboratory animals (ATSDR, 1989).

No studies have reported death in humans following exposure to ethylbenzene. Studies in laboratory animals do suggest that ethylbenzene can cause death. There is no clear evidence that reproductive effects occur following inhalation, ingestion, or dermal contact with ethylbenzene. Birth defects have occurred in newborn animals when the mothers were exposed to ethylbenzene. These effects become increasingly serious with increasing doses of ethylbenzene. A single long-term study in animals suggested that ethylbenzene caused tumors. However, the study had many weaknesses and conclusions could not be drawn regarding the possible carcinogenic effects in humans (ATSDR, 1989).

IRIS listed an oral RfD for ethylbenzene of 1.0E-01 mg/kg-day. This value was based on a subchronic bioassay in which rats were administered 13.6, 136, 408 or 680 mg/kg-day ethylbenzene by gavage 5 days/week. The LOAEL (Lowest Observed Adverse Effect Level) of 408 mg/kg/day was associated with histopathologic changes in liver and kidney. The NOEL (No Observed Effect Level) established in this study was 136 mg/kg-day (converted to 97.1 mg/kg-day to reflect treatment 7 days/week). IRIS listed an inhaled reference concentration (RfC) chronic inhalation of ethylbenzene as 1.0E+0 mg/m^3. IRIS considers the confidence of this value to be low, however.

An uncertainty factor of 1000 (10x each for intraspecies and interspecies variability and 10x for extrapolation of subchronic effect level to its chronic equivalent) was used to derive the RfD. The level of confidence in the RfD is low and reflects the fact that only one sex was tested and that the experiment was not of chronic duration. The inhalation RFC is listed as 1.0E+00 mg/m^3 in IRIS.

EPA has classified ethylbenzene as Group D--Not Classifiable as to Human Carcinogenicity. This classification was due to lack of animal bioassays and human studies. Therefore, there is no slope factor at this time.

References

ATSDR, *Draft Toxicological Profile for Ethylbenzene*, 1989

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G.18 4,4'-DDD, 4,4'-DDE and 4,4'-DDT

Typically, people are not exposed to 4,4'-DDT, -DDD, or -DDE individually, but rather to a mixture of all three, since 4,4'-DDE and 4,4'-DDD are contaminants of and degradation and metabolic products of 4,4'-DDT. Therefore, the toxicities of DDT, DDE, and DDD should be considered jointly. The human and animal health effects that result from inhalation of 4,4'-DDT, -DDE, or -DDD are currently unknown. The health effects resulting from human exposure to 4,4'-DDT, -DDE, or -DDD in water are also unknown at this time. However, single human exposures to 4,4'-DDT, -DDE, or -DDD in food at doses of 214-571 ppm have resulted in headache, nausea, vomiting, increased heart rate, and convulsions. Long-term human exposures (18 months) to lower doses (22 ppm) of the three compounds in food caused no adverse health effects (ATSDR, 1989).

4,4'-DDD--The health effects resulting from exposure of animals to 4,4'-DDD in water are not known. A NOAEL of 26 mg/kg-day was identified during short-term exposure (1 week) of mice to 4,4'-DDD in the diet. Exposure of rats to 1221 mg/kg-day 4,4'-DDD for 16 days resulted in atrophy of the thymus. NOAELs of 165 and 107 mg/kg-day were identified in chronic studies (78 weeks) using rats and mice, respectively. However, at 85 mg/kg-day, exposure to 4,4'-DDD resulted in thyroid tumors in rats. In a separate study, exposure to 32.5 mg/kg-day 4,4'-DDD caused lung tumors in mice (ATSDR, 1989).

Neither IRIS nor HEAST list an oral RfD, inhalation RfD or inhalation RfC.

4,4'-DDD is a Group B2 - Probable Human Carcinogen. This classification is based on the induction of lung tumors in male and female mice, liver tumors in male mice and thyroid tumors in male rats. There are no human carcinogenicity data. The oral slope factor, as given by IRIS, is 2.4E-01 $(mg/kg\text{-}day)^{-1}$. The supporting study used an adequate number of animals, but the slope factor was derived using tumor incidence data from one dose. There is no inhalation unit risk at this time.

4,4'-DDE--The health effects resulting from exposure of animals to 4,4'-DDE in water are not known. Exposure of mice (by gavage) to 26 mg/kg-day 4,4'-DDE for 24 hr/day for one week caused alterations in the liver. When rats were exposed to 28 mg/kg-day 4,4'-DDE by gavage on gestation days 15-19, a decrease in the weight of the ovaries was noted. A NOAEL of 42 mg/kg-day was identified in a long-term (78 weeks) study in which rats were fed 4,4'-DDE in the diet. Hamsters fed 41.5 mg/kg-day 4,4'-DDE for 128 weeks exhibited necrosis of the liver and when 4,4'-DDE was administered by gavage, tumors of the liver were observed. When mice were exposed to 19 mg/kg-day 4,4'-DDE in the diet for 78 weeks, liver tumors were also observed (ATSDR, 1989).

There is no RfD or RfC for DDE in IRIS or HEAST .

4,4'-DDE is classified as a group B2 - Probable Human Carcinogen. This classification is based on increased incidence of liver tumors including carcinomas in two strains of mice and in hamsters and thyroid tumors in female rats when 4,4'-DDE is given in the diet. Human data are not available. The oral slope factor is 3.4E-01 $(mg/kg\text{-}day)^{-1}$. This value is the geometric mean of six slope factors computed from incidence data by sex. There is no inhalation slope factor for DDE.

4,4'-DDT--The primary effect of short-term exposure to high levels of 4,4'-DDT is on the nervous system. Oral ingestion of large quantities of 4,4'-DDT have resulted in

excitability, tremors, and seizures in humans. Irritation of the eyes, nose, and throat have been reported by people who have come in contact with 4,4'-DDT. Exposure to low doses of DDT on a long-term basis has resulted in changes in the levels of liver enzymes involved in metabolism of drugs and chemicals but there was no indication that 4,4'-DDT caused irreversible damage (ATSDR, 1989).

Studies conducted in laboratory animals suggest that exposure to 4,4'-DDT may have harmful effects on reproduction and may result in an increased occurrence of liver tumors. However, five studies of 4,4'-DDT exposure in humans did not show increases in the number of deaths or cancers (ATSDR, 1989). Increasing evidence indicates that pesticides, including 4,4'-DDT, can alter immune function in rodents although studies in humans are limited and ambiguous. In a study of pesticide formulators in India, 73% of workers exposed to 4,4'-DDT had altered levels of serum immunoglobulins although no increase in infections was noted.

The oral RfD for 4,4'-DDT is listed in IRIS as 5E-04 mg/kg-day. This value is based on a chronic rat feeding study in which 4,4'-DDT was provided in the diet. Weanling rats were fed commercial DDT in doses of 0, 1, 5, 10, or 50 ppm for 15-27 weeks. Increasing hepatocellular hypertrophy was seen at doses of 5 ppm and greater. Therefore, 5 ppm was established as a LOAEL. A NOAEL of 1 ppm (converted to 0.05 mg/kg-day) was also established in the study. An uncertainty factor of 100 was used to account for interspecies conversion and to protect sensitive human subpopulations (10x each). An uncertainty factor for subchronic to chronic conversion was not included because of corroborating chronic data in the data base. A confidence rating of medium was associated with the RfD and reflects that the principal study was adequate but of shorter duration than desired. There are no values for the inhalation RfD or RfC at this time. HEAST lists the subchronic oral RfD as 5.0E-04 mg/kg-day.

4,4'-DDT is classified as Group B2 - Probable Human Carcinogen. This classification is based on tumors (usually liver) in various mouse strains and three rat studies. Human carcinogenicity data is inadequate. The oral slope factor listed in IRIS is 3.4E-01

(mg/kg-day)$^{-1}$. The inhalation unit risk is listed in IRIS as 9.7E-05 (mg/m^3)$^{-1}$. HEAST lists an inhalation slope factor of 3.4E-01 (mg/kg-day)$^{-1}$.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1989) Toxicological Profile for p,p'-DDT, DDE, DDD. U.S. Dept. of Health and Human Services, Atlanta, GA.

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G.19 Dibenzofuran

Neither IRIS nor HEAST lists toxicity values for dibenzofuran, and there is not an established MCL for dibenzofuran in *Drinking Water Regulations and Health Advisories* (USEPA, 1991). However, EPA Region III lists a chronic oral reference dose of 4.0 E-03 (mg/kg/day) in its Risk-Based Concentration Table (USEPA, 1995).

Dibenzofuran is an USEPA Group D Carcinogen - Not Classifiable as to Human Carcinogenicity. No data are available concerning the toxicity of dibenzofuran in humans or laboratory animals. However, a risk assessment for dibenzofuran is currently under review by a USEPA work group.

References

USEPA, 1991. *Drinking Water Regulations and Health Advisories.*

USEPA, 1995. Risk-Based Concentration Table, Januanry - June 1995. United States Environmental Protection Agency Region III. March 7, 1995.

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G.20 Dibromomethane

Dibromomethane is a liquid (boiling point = 97°C) that is soluble in water to 1%. Although specific data are limited, Dibromomethane is expected to be hepatotoxic in mammals. Hepatotoxicity among the halogenated methanes is related to the ease that a halogen can be removed to yield a reactive metabolite (Andrews and Snyder, 1991). Consequently, toxic potency increases as 1) the number of halogen substitutions increases and 2) the atomic weight of the halogen increases. For example, dichloromethane and chlorobromomethane produce fatty liver without necrosis. Carbon tetraiodide, carbon tetrabromide, carbon tetrachloride, iodoform, bromoform, and chloroform can cause both fatty livers and necrosis.

Halogenated methanes have a narcotic effect on the central nervous system. High concentrations can cause confusion, giddiness, and disorientation progressing to unconsciousness and death (Andrews and Snyder, 1991). Metabolism of dihalomethanes by mixed function oxidases involves dehalogenation and formation of carbon monoxide. As a result, elevated carboxyhemoglobin levels may be seen (Nitschke et al., 1988). Dibromomethane was mutagenic in bacterial assays. A positive response was seen in Salmonella typhimurium strain TA100 in a preincubation assay. Mutagenicity was enhanced by the presence of metabolic activation (Van Bladeren et al., 1980).

A Reference Dose for dibromomethane has not been determined. The Threshold Limit Value is for dibromomethane is 5 ppm (8-hour time weighted average) (ACGIH, 1993-1994). For comparison, dichloromethane has a Reference Dose of 0.06 mg/kg/day and a Threshold Limit Value of 50 ppm (8-hour time weighted average).

References

ACGIH (American Conference of Governmental Industrial Hygienists) (1993-1994) 1993-1994 Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices. ACGIH, Cincinnati, OH.

Andrews, L. S. and R. Snyder (1991) "Toxic Effects of Solvents and Vapors". In: Casarett and Doull's Toxicology. The Basic Science of Poisons, Fourth Edition, (M. O. Amdur, J. Doull, and C. D. Klaassen, Eds.), McGraw-Hill, New York, pp. 681-722.

Nitschke, K. D., J. D. Burek, T. J. Bell, R. J. Kociba, L. W. Rampy, and M. J. McKenna (1988) "Methylene Chloride: 2 Year Inhalation Toxicity Study and Oncogenicity Study in Rats". Fund. Appl. Toxicol. 11: 48-59.

Van Bladeren P.J. (1980) Mutation Res. 74: 341-346.

Revised/updated by VLR 13 December 1994

G.21 1-2-Dichloroethane

Acute inhalation of 1,2-dichloroethane has caused death in humans as well as well as laboratory animals. Inhalation of intermediate to high levels of the chemical has caused pulmonary and cardiac lesions, congestion of the gastrointestinal tract, increased prothrombin clotting time, enlarged liver, high serum levels of lactate and ammonia, increased levels of SGOT and SGPT, nephritis, and chronic splenitis. Chronic inhalation of lower levels of 1,2-dichloroethane has shown to cause slight liver damage.

The toxicity of ingested 1,2-dichloroethane is well documented in laboratory animals. Target organs include: immune system, central nervous system, liver, and kidney. 1,2-dichloroethane has also produced carcinogenic and genotoxic effects in animals exposed orally (ATSDR, *Toxicological Profile for 1,2-Dichloroethane*, 1992).

An oral RfD for 1,2-dichloroethane has not been established. EPA Region III however, provides an inhalation RfD of 2.9 E-3 mg/kg/day in its Risk-Base Concentration Table (US EPA, 1995). This value was used to calculate an inhalation Reference Concentration (RfC) of 1.0 E-2 mg/m^3 by assuming an inhalation rate of 20 m^3/day and a body weight of 70 kg.

EPA classifies 1,2-dichloroethane as Group B2--Probable Human Carcinogen. This is based on the induction of several tumor types in rats and mice treated by gavage and lung

papillomas in mice after topical application. IRIS lists an oral slop factor of 9.1E-02 (mg/kg-day)$^{-1}$ and an inhalation unit risk value of 2.6E-05 ($\mu g/m^3$)$^{-1}$.

References

USEPA, 1995. Risk-Based Concentration Table, January - June 1995. USEPE, Region III, March 7, 1995.

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G.22 1,1-Dichloroethene

Little information is available on the health risks associated with exposure to 1,1-dichloroethene. An ATSDR document was not available. The information presented here was obtained from IRIS and HEAST.

IRIS lists an oral RfD for 1,1-dichloroethene as 9.0E-3 mg/kg/day. A NOEL was not established, but a LOAEL of 50 ppm (9 mg/kg/day) was determined. The RfD was based on a chronic oral bioassay of 1,1-dichloroethene in rats. Rats were given 50, 100, or 200 ppm 1,1-dichloroethene in drinking water for 2 years. The only pathologic findings were hepatic lesions. These lesions were seen in all female rat treated groups. A significant increase in the incidence of these lesions were seen in the male rats that received 200 ppm, but this trend was observed in the male rats who received the 100 ppm dose. Beagles were also administered 1,1-dichloroethene, but did not show any adverse effects. Due to the results of the above study and available literature, the liver has been determined to be the most sensitive organ to the effects of 1,1-dichloroethene. The rat has been found to be the most sensitive species. 1,1-dichloroethene has been shown to be phytotoxic, but not teratogenic in rodents after exposure to 1,1-dichloroethene in drinking water or by inhalation. The confidence in the RfD is medium, although the appropriate number of animals and two species were studied because no chronic or subchronic oral bioassays were conducted. HEAST lists the subchronic oral RfD as 9.0 E-3 mg/kg/day.

No RfC is available in either IRIS or HEAST for 1,1-dichloroethene. A risk assessment is under review by the EPA at this time.

1,1-dichloroethene is considered by the EPA to be a possible human carcinogen (Class C). This determination was based on the observation of tumors in mice after inhalation exposure. This compound is also known to be mutagenic, and has a metabolite known to alkylate and covalently bind to DNA. It is structurally similar to the known human carcinogen vinyl chloride. IRIS lists an oral slope factor of 6.0E-1 per (mg/kg)/day for 1,1-dichloroethene, and an inhalation unit risk of 5.0E-5 per (microg/m^3).

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G.23 1,2-Dichloroethene

cis-1,2-Dichloroethene

There are few studies regarding the toxicity of cis-1,2-dichloroethene alone. 1,2-dichloroethene is usually found as a mixture of both the cis and trans isomers. It is known that the inhalation of high concentrations of 1,2-DCE has caused central nervous system depression in humans. The effects of cis-1,2-dichloroethene in humans or laboratory animals has not been extensively investigated.

HEAST lists a chronic oral RfD as 1.0E-02 mg/kg-day and the subchronic oral RfD as 1.0E-01 mg/kg-day. Cis-1,2-Dichloroethene is a Group D Carcinogen -- Not Classifiable as to Human Carcinogenicity.

trans-1,2-Dichloroethene

Pathological changes (i.e., pulmonary capillary hyperemia, alveolar septal distension, and pulmonary edema) were observed in the lungs of rats following inhalation of

trans-1,2-dichloroethene. Effects have also been observed on the cardiovascular system, on circulating leukocytes and erythrocytes, and the liver following inhalation exposure to trans-1,2-DCE. After ingestion of the compound, laboratory animals have shown effects on the respiratory system, liver, and kidneys. These findings have not been thoroughly investigated in humans. No studies are available regarding the dermal toxicity of trans-1,2-DCE.

IRIS lists the chronic oral RfD as 2.0E-02 mg/kg-day and HEAST provides 2.0E-01 mg/kg-day as the subchronic oral RfD. These values were derived from the results of a subchronic study in mice. The critical effect was an increased serum alkaline phosphatase level in male mice in the medium and high dose groups. Female mice in the medium and high dose groups exhibited a decreased thymus weight. No other treatment-related effects were observed.

G.24 Dieldrin

Upon entry into the environment, aldrin is rapidly converted to dieldrin, its corresponding epoxide. Dieldrin is lipid-soluble and stored in adipose tissue of humans and other animals. Aldrin and dieldrin cause similar adverse health effects. No increase in mortality from any cause has been reported in workers who have been employed in the manufacture of dieldrin for more than four years. However, long-term exposure to moderate levels of dieldrin causes headaches, dizziness, irritability, vomiting, or uncontrollable muscle movements. CNS excitation culminating in convulsions was the principal toxic effect noted in occupational studies of workers employed in the manufacture or application of dieldrin. Short-term exposure to high levels of dieldrin causes convulsion and kidney damage. Long-term exposures to lower levels may also cause convulsions as a result of the potential for dieldrin to accumulate within the body.

The carcinogenic and reproductive/developmental effects of dieldrin in humans are currently unknown. Experimental studies indicate that animals born to mothers that were fed dieldrin do not live long (ATSDR, 1992). One study revealed detectable levels of dieldrin in the human placenta, amniotic fluid, and fetal blood. These results suggest that dieldrin can pass through the human placenta and accumulate in the developing fetus.

The oral RfD for dieldrin is listed in IRIS as 5E-05 mg/kg/day. This value was based on a chronic (2-year) rat feeding study. The critical effect noted in the study was liver lesions. HEAST lists a value of 5.00E-05 mg/kg/day for the subchronic oral RfD.

The uncertainty factor used to derive the RfD for dieldrin is 100. This factor allows for the extrapolation of dose levels from animals to humans and the uncertainty in the threshold for sensitive humans. The confidence level for the RfD value is medium. The principal study is an older study for which detailed data are not available. The chronic toxicity evaluation is relatively complete and supports the critical effect. The RfD is given a medium

confidence rating based on support for the critical effect from other dieldrin studies. Confidence in the study is low. However, confidence in the database is medium.

Dieldrin is a Group B2 -Probable Human Carcinogen. This is based on the fact that dieldrin is carcinogenic in seven strains of mice when given orally. It is also structurally similar to aldrin, chlordane, heptachlor, heptachlor epoxide, and chlorendic acid, which are tumorgens. The oral slope factor listed by IRIS is 1.6E+1 $(mg/kg/day)^{-1}$ and is the geometric mean of 13 slope factors calculated from liver carcinoma data in both sexes of several strains of mice. The inhalation unit risk listed by IRIS is 4.6E-03 $\mu g/m^3$, based on oral data. HEAST lists a value of 1.6E+01$(mg/kg/day)^{-1}$ for the inhalation slope factor.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1992) Toxicological Profile for Aldrin/Dieldrin. U.S. Dept. of Health and Human Services, Atlanta, GA.

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G.25 2,4-Dimethylphenol

There is very little information regarding the toxicity of 2,4-dimethylphenol. IRIS lists a chronic oral RfD of 2E-02 mg/kg-day for the compound while HEAST shows the subchronic oral RfD as 2E-01 mg/kg-day. These values are based on a subchronic oral gavage study in mice where the critical effect was lethargy, prostration, ataxia, and hematological changes. The confidence rating for the RfD is low since there are not corroborative studies and since the critical study was subchronic in duration. Currently, EPA has not assigned 2,4-dimethylphenol a caranogenicity classification.

G.26 Heptachlor

Heptachlor is a major component of the pesticide chlordane and a pesticide in its own right. Information regarding human health effects from exposures to heptachlor is sparse. Tremors and convulsions have been reported in experimental animals exposed orally to high levels of heptachlor for short periods of time (ATSDR, 1992). Long-term exposure to heptachlor may adversely affect the liver. Animals fed heptachlor in an experimental setting have been reported to have enlarged livers, liver damage, kidney damage, and increased red blood cell count. Tremors and convulsions have also been reported in animals exposed to heptachlor on a long-term basis (ATSDR, 1992).

Evidence which supports an association between heptachlor and infertility or improper development of offspring includes animal studies showing: 1) females are less likely to be impregnated when both males and females were fed heptachlor; 2) and rats born to dams fed heptachlor during pregnancy tended to develop cataracts. Heptachlor has also been reported to cause liver cancer when fed to animals (ATSDR, 1992).

The chronic oral RfD for heptachlor is listed as 5E-04 mg/kg/day in IRIS. This is based on a two-year study in which rats were fed 0, 1.5, 3, 5, 7, or 10 ppm heptachlor. The two highest doses caused liver lesions characteristic of chlorinated hydrocarbon exposure. The

NOEL was 5 ppm for the lesions and 3 ppm for males with increased liver-to-body weight ratios.

Based on a chronic exposure study, an oral RfD uncertainty factor of 100 was used to account for interspecies and intraspecies differences. An additional factor of 3 was considered appropriate because of the lack of chronic toxicity confirmation in a second species, for a total uncertainty factor of 300. The confidence level was low because of low study quality and incomplete chronic toxicity data in the database. The subchronic oral RfD (5E-4 mg/kg/day) is the same as the chronic oral RfD according to HEAST.

There are no inhalation RfD or RfC values listed at this time.

Heptachlor is a Group B2 - Probable Human Carcinogen. There are inadequate human data, but sufficient evidence exists from studies in which benign and malignant liver tumors were induced in three strains of mice of both sexes. It is also structurally similar to several other liver carcinogens. The oral slope factor is 4.5 $(mg/kg/day)^{-1}$ and is the geometric mean of the slope factors from four mouse data sets. Adequate numbers of animals were treated, and the incidences of malignant lesions were significantly increased in each data set. The inhalation unit risk was listed in IRIS as 1.3E-03 $(\mu g/m^3)^{-1}$. The inhalation slope factor is listed in HEAST as 4.5E+00 $(mg/ka/day)^{-1}$.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1992) Toxicological Profile for Heptachlor/Heptachlor Epoxide. U.S. Dept. of Health and Human Services, Atlanta, GA.

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G.27 Heptachlor Epoxide

Upon entering the body, heptachlor is metabolized to heptachlor epoxide and other related chemicals. Heptachlor epoxide is more harmful than heptachlor, primarily because of its ability to be stored in fat for long periods of time. The breakdown products of heptachlor epoxide

are generally are less toxic. Long-term exposure to heptachlor epoxide may adversely affect the liver. Animals fed heptachlor epoxide in an experimental setting have been reported to have enlarged livers, liver damage, kidney damage, and increased red blood cell count.

Placental transfer of heptachlor epoxide has been reported following inhalation exposure. Heptachlor epoxide has also been identified in breast milk. This compound has been detected in stillborn infant brain, adrenal, lung, heart, liver, kidney, spleen, and adipose tissues. However, the studies reporting these findings were limited by lack of data concerning route, duration, extent of exposure, and number of cases examined. No gross malformations were reported in any of the stillborn infants. Although a developing fetus could be exposed to heptachlor epoxide transplacentally, the existing data are inadequate to establish a relationship between exposure and human developmental toxicity (ATSDR, 1992).

The oral RfD for heptachlor epoxide is listed as 1.3E-05 mg/kg/day in IRIS. This value is based on a chronic feeding study conducted in dogs fed diets containing 0, 0.5, 2.5, 5, or 7.5 ppm of heptachlor epoxide for 60 weeks. The critical effect noted in the study was treatment-related increases in liver-to-body weight ratios. Effects were noted in both males and females and a Lowest Effect Level (LEL) of 0.5 ppm was established. A NOEL was not established in this study.

An uncertainty factor of 1000 was used to account for inter- and intra-species differences and because a NOEL was not established in the study. The confidence associated with the oral RfD was low, reflecting that the principal study was of low quality and that the database on chronic toxicity is complete but consists of low quality studies. The subchronic RfD listed in HEAST is the same as the chronic RfD (1.3E-05 mg/kg/day) listed in IRIS.

Heptachlor epoxide is classified by the USEPA as Group B2 - Probable Human Carcinogen. Sufficient evidence exists from rodent studies in which liver carcinomas were induced in two strains of mice of both sexes and in CFN female rats. It is also structurally similar to several other liver carcinogens. There are no published epidemiologic evaluations of heptachlor epoxide. The oral slope factor listed in IRIS is 9.1E+00 $(mg/kg/day)^{-1}$. An inhalation unit risk of 2.6E-03

μg/m^{-3} was calculated from oral data. HEAST lists a value of 9.1E+00 (mg/kg/day) for the inhalation slope factor.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1992) Toxicological Profile for Heptachlor/Heptachlor Epoxide. U.S. Dept. of Health and Human Services, Atlanta, GA.

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G.28 2-Hexanone

Workers exposed to 2-Hexanone for almost a year experienced weakness, numbness, and tingling in the skin of the hands and feet. In animals that ingested or breathed 2-Hexanone, weakness, clumsiness and paralysis were seen. Subchronic effects in animals that inhaled pure 2-Hexanone included nerve damage, weakness in the legs, a decreased number of white blood cells, and decreased weight of testes. Paralysis was seen in rats who ingested 2-Hexanone for more than 14 days and similar effects were seen after dermal contact (ATSDR, 1990).

An outbreak of distal polyneuropathy was reported in a fabric plant using 2-hexanone for about 10 months. Eight of 86 employees showing symptoms had weight losses of 3 to 60 pounds and moderate to severe neurological impairment. Other employees had mild sensory impairment and electrodiagnostic abnormalities. The concentration of 2-hexanone averaged 9.2 ppm in front of fabric printing machines and about 36 ppm behind the machines. After use of 2-hexanone was discontinued, weight gain was uniformly noted in those that had lost weight. Other chemicals, such as methyl ethyl ketone, may have been present in the atmosphere (ATSDR, 1990).

Developmental effects in rats exposed to 1,000 ppm or 2,000 ppm 2-hexanone (purity not stated) during gestation included hyperactivity in the young and decreased activity in the geriatric stage. Also noted was decreased rate of avoidance learning in puberty-aged females of treated dams

and increased random movement in puberty-aged and adult offspring of treated dams (ATSDR, 1990).

Toxicity values for 2-hexanone are not available in IRIS or HEAST. An LD_{50} of 2,590 mg/kg was calculated for gavage administration of 2-hexanone to rats. No deaths occurred in 24 hours in rats given 1,500 mg/kg by gavage. The NOAEL for acute exposure resulting in hepatic and renal effects was reported to be 1,500 mg/kg-day in rats. A LOAEL of 660 mg/kg-day was reported for a 90 day study resulting in weight loss in rats. For intermediate exposure (40 weeks), a NOAEL of 400 mg/kg-day resulting in hepatic and renal effects in rats was reported. In guinea pigs, a LOAEL of 600 mg/kg-day resulted in abnormal pupil response and in hens, a LOAEL of 100 mg/kg-day resulted in ataxia (ATSDR, 1990).

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1990) Toxicological Profile for 2-Hexanone. U.S. Dept. of Health and Human Services, Atlanta, GA.

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G.29 Lead

Lead is found in nearly all phases of the environment and in most biologic systems. The principal route of exposure is in food, but other important sources include lead-based paints, auto exhaust, industrial emissions, and lead glazed pottery used in food service. Lead absorption from the gastrointestinal tract or through the respiratory system is dependent upon a number of factors. Children are known to absorb a greater percentage of lead from the diet than adults. Although lead produces a variety of toxic effects depending upon the route of exposure and its chemical form, the most important effect of lead is its adverse effect on cognitive abilities and motor skills in young children. Low level exposure to lead during infancy and childhood increases the risk of irreversible neurobehavioral deficits at levels of internal exposure as low as 10 to 15 μg/dL in

blood. Other target organs include the kidneys, red blood cells, and the gastrointestinal and reproductive tracts (ATSDR, 1992).

Much information about the health effects of lead has been obtained through decades of medical observation and scientific research. Therefore, the degree of uncertainty about the health effects of lead is quite low by comparison to most other environmental toxicants. The standard approach for quantifying the effects of a chemical relies on identifying the dose associated with adverse effects. This approach has not been successful for lead. Lead is found ubiquitously in the environment and, therefore, it is difficult (if not impossible) to isolate the route of exposure and characterize the effects of lead with varying dose. In addition, it appears that some of the health effects associated with lead, particularly those affecting children (neurobehavioral development) may essentially be without a threshold. The U.S. EPA's Agency RfD Work Group currently considers it inappropriate to develop an RfD for inorganic lead. RfD methodologies are not flexible enough to incorporate site specific information on lead exposure sources and demographic information because they are fundamentally route specific (ATSDR, 1992).

The most current regulatory level of control for lead is the maximum contaminant level goal (MCLG) listed in IRIS of zero mg/L lead and the action level of 0.015 mg/L for lead recently finalized by the Office of Drinking Water. The MCLG is based upon the health effects of lead in infants and pregnant women as a sensitive subpopulation. An OSWER memorandum entitled "Cleanup Level for Lead in Groundwater" (June 21, 1990) summarized data from several U.S. EPA reports that indicated that steady-state exposure to drinking water lead concentrations of 0.015 mg/L would result in blood levels below the concern level of 10 µg/dL in 99% of young children who are not concurrently exposed to excessive lead paint exposure or heavily contaminated soils (U.S. EPA, 1990). However, the range of 10-15 µg/dL is regarded as a level of concern, warranting medical attention, and not a dose level or threshold below which no adverse health effects would be expected to occur. In other words, it is not strictly parallel to the definition of an RfD. Therefore, it was considered inappropriate to derive a daily dose associated with this concentration in drinking water for use as a surrogate RfD. This approach would have ignored the contribution of lead from

background sources and was not considered to be sufficiently protective of young children from the developmental effects of lead.

The U.S. EPA has classified lead as Group B2 - Probable Human Carcinogen. Quantifying the cancer risk associated with lead involves many uncertainties, some of which may be unique to lead. Age, health, nutritional state, body burden, and exposure duration influence the absorption, release, and excretion of lead. Current knowledge of lead pharmacokinetics indicates that an estimate derived by standard procedures would not truly describe the potential risk. Therefore, a cancer slope factor has not been calculated for lead.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1992) Toxicological Profile for Lead. U.S. Dept. of Health and Human Services, Atlanta, GA.

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G.30 Manganese

Inhalation of manganese particulates can lead to an inflammatory response in the lungs. This reaction has been observed in both man and laboratory animals and is not unique to manganese. It is, instead, characteristic of nearly all inhalable particulate matter. There is conclusive evidence in humans, however, indicating that inhaling high levels of manganese can result in a disabling neurological syndrome that is accompanied by apathy, general weakness, dullness, anorexia, and muscle pain. Impotence and loss of libido are common signs in male workers exposed to relatively high levels of manganese in the air (ATSDR, 1990).

Most animal studies indicate that manganese has a low acute oral toxicity. No adverse health effects were seen in mice given 810 mg/kg/day during a chronic feeding study. There are no studies available at this time regarding health effects in humans or laboratory animals following dermal exposure to manganese (ATSDR, 1990).

IRIS lists the chronic oral RfD for manganese in water as 5.0E-03 mg/kg/day and in food as 1.4E-01 mg/kg/day. HEAST lists the subchronic oral RfD for manganese in water as 5.0E-3 mg/kg/day and the subchronic RfD for manganese in food as 1.4E-1 mg/kg/day.

The uncertainty factor for the oral RfD of Manganese is 1. This is based on many large populations consuming normal diets over an extended period of time with no adverse health effects. The available information provides a chronic NOAEL in many cross-sections of human populations. For the drinking water RfD, an uncertainty factor of 1 is also applied. The study group is considered to comprise a sensitive subpopulation. No one study is used to derive the.dietary RfD. No information is available to indicate toxic levels in the human diet. Confidence in the database is medium as is confidence in the oral RfD.

IRIS lists an inhalation RfC of 5.0E-05 mg/m^3 based on an increased prevalence of respiratory symptoms and psychomotor disturbances in male workers occupationally exposed to inorganic manganese.

The uncertainty factor for the RfC is 1000. This takes into account protection of sensitive individuals, use of a LOAEL, and database limitations. Also taken into consideration is the less than chronic period of exposure.

The confidence level for the RfC is medium. In the principal study and supporting studies, adequate numbers of manganese workers were matched with adequate numbers of control workers, but no monitoring data were available to characterize past manganese levels. Confidence in the database is also medium.

The U.S.EPA considers manganese a Group D Carcinogen, or Not Classifiable as to Human Carcinogenicity. The basis for this classification is the absence of human studies and the inadequacy of existing animal studies regarding carcinogenic potential. Classification of a chemical as Group D precludes quantitative toxicity assessment. Therefore, no slope factor was listed for manganese in either IRIS or HEAST.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1990) Toxicological Profile for Manganese. U.S. Dept. of Health and Human Services, Atlanta, GA.

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G.31 Methylene Chloride

Based on the results from experimental studies, exposure to methylene chloride vapors may cause irritation of the eyes and damage the cornea. One study reported these effects at 400 ppm, however, the effects usually disappeared within a few days. Inhalation of 300 ppm or greater concentrations of methylene chloride for short periods of time (3 to 4 hours), may result in a slight, but temporary hearing loss and slight vision impairment. Inhalation of higher concentrations (800 ppm) may result in slowed reaction time, loss of balance and stability, and decreased ability to perform tasks requiring fine motor skills. Longer exposures may cause dizziness, nausea, tingling or numbness of the fingers and toes, and drunkenness. In most cases, these effects disappear upon cessation of exposure. Studies conducted in experimental animals suggest that exposure to higher concentrations (greater than 1,000 ppm) can lead to unconsciousness and death (ATSDR, 1992).

Inhalation of methylene chloride has been reported to cause changes in the liver and kidneys of animals but similar effects have not been observed in humans. Studies conducted with laboratory animals indicated that inhalation of methylene chloride does not cause birth defects or affect reproduction, even at high concentrations. Methylene chloride has not been associated with cancer in humans exposed to vapors in the workplace. However, inhalation of high concentrations for long periods of time did cause cancer in mice. No information was located in the available literature regarding the effects of methylene chloride in humans following oral exposure. Methylene chloride has resulted in the death of rats orally exposed to large quantities over a short period of time. No information was located on the health effects associated with dermal contact with methylene chloride (ATSDR, 1992).

IRIS lists a chronic oral RfD of 6.0E-02 mg/kg-day. The subchronic RfD listed in HEAST is the same value. This is based on a chronic drinking water bioassay conducted in rats. Rats received 5, 50, 125 or 250 mg/kg-day methylene chloride for two years. Histologic alterations of the liver were evident at doses of 50 mg/kg-day or higher. Low dose of 5.85 and 6.47 mg/kg were established as the NOAELs for male and female rats, respectively.

An uncertainty factor of 100 was applied to account for intra- and interspecies variability to the toxicity in lieu of specific data (10x each). The level of confidence in the oral RfD is medium. This rating reflects that the critical study was well performed but that only a few studies support the NOAEL. HEAST lists both the chronic and subchronic inhalation RfC as 3.0E+00 mg/m^3. However, the chronic RfC is currently under review by USEPA work group and, therefore, the number may change.

USEPA has classified methylene chloride as a Group B2--Probable Human Carcinogen. There is sufficient evidence of carcinogenicity in animals including increased incidence of hepatocellular neoplasms and alveolar/bronchiolar neoplasms in mice, benign mammary tumors in rats, salivary gland sarcomas in male rats and leukemia in female rats. However, the human carcinogenicity data are considered inadequate for use in classifying this compound. IRIS lists the oral slope factor as 7.5E-03 $(mg/kg\text{-}day)^{-1}$. IRIS also lists an inhalation unit risk factor of 4.7E-07 $(\mu g/m^3)^{-1}$.

References

ATSDR, *Draft Toxicological Profile for Methylene Chloride*, 1992

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G.32 Methyl Ethyl Ketone

Little information is available on the toxicity of methyl ethyl ketone. In fact, methyl ethyl ketone has been suggested as a replacement for two similar industrial solvents (n-hexane and methyl *n*-butyl ketone) because of its apparent lack of neuropathologic effects (Lauwerys, 1991).

The oral RfD for methyl ethyl ketone of 6.0E-1 mg/kg/day was listed in IRIS. HEAST lists a subchronic RfD of 2.0 E+0 mg/kg/day. IRIS also lists a chronic inhalation RfC of 1.0 E+0 mg/m^3.

EPA has classified methyl ethyl ketone as Group D - Not Classifiable as to Human Carcinogenicity due to inadequate animal data and no human carcinogenicity data. Therefore, no slope factor is listed.

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G.33 2-Methylnaphthalene

Currently there are no toxicity information available to quantify the adverse health effects of 2-methylnaphthalene. In the absence of these data, the USEPA Superfund Health Risk Technical Support Center was contacted for further guidance (Personal Communication, August, 1994).

In their response, the Technical Support Center stated that EPA has not derived any toxicity information for 2-methylnaphthalene, nor is this chemical under consideration by the RfD/RfC Work Group. Additionally, no occupational guidelines and/or regulations were located for this PNA.

EPA further stated, "studies regarding health effects in humans or animals following inhalation, oral, or dermal exposure to 2-methylnaphthalene are not available, but data are available on metabolism and health effects following acute intraperitoneal injection of this PNA in rodents. By themselves, these data do not provide a sufficient base for the derivation of an RfC for 2-methylnaphthalene." Because of the lack of toxicity data available for 2-methylnaphthalene, EPA's Technical Support Center did not provide provisional toxicity value(s) for this analyte.

G.34 Pentachlorophenol

Limited data exists regarding the effects of inhalation exposure of pentachlorophenol in humans or animals. Often, pentachlorophenol is contaminated with compounds such as chromium, dioxins, dibenzofurans, and arsenic; therefore, it is difficult to discern if toxic effects are actually a result of pentachlorophenol. It is known that dusts from pentachlorophenol and its sodium salt are particularly irritating to the eyes and nose. Low grade inflammation of the skin and subcutaneous tissue, conjunctival membrane of the eyes, and severe eruptions of the skin. Also, a brief report suggests that prolonged exposure to commercial pentachlorophenol-containing wood preservatives may be associated with endocrine and immunologic dysfunction and reproductive disorders.

Evidence of biochemical and gross changes in the liver of rodents orally exposed for a chronic duration to pentachlorophenol exists. Mild renal toxicity (increased organ weight and altered enzyme levels) has also been observed in lab animals after subchronic/chronic oral administration. Immunological toxicity, developmental effects, and the formation of hemangiosarcomas have been attributed to oral exposure with pentachlorophenol in lab animals (ATSDR, *Toxicological Profile for Pentachlorophenol*, 1992).

IRIS lists a chronic oral RfD for pentachlorophenol as 3E-02 mg/kg-day. The same value is listed in HEAST for the subchronic oral RfD. These values are based on a chronic oral study in rats where liver and kidney lesions were the critical effect. The confidence rating in the RfD

is medium. Currently, no inhalation RfCs have been developed for pentachlorophenol, but an EPA work group is reviewing the data.

Pentachlorophenol is classified as a Group B2--Probable Human Carcinogen. EPA has made this assignment due to the increased incidences of multiple biologically significant tumor types and two uncommon tumor types (adrenal medulla pheochromocytomas and hemangiosarcomas). This classification is also supported by mutagenicity data. IRIS lists an oral cancer slope factor of 1.2E-01 mg/kg-day for pentachlorophenol. An inhalation unit risk value has not been developed for this compound.

G.35 Polynuclear Aromatic Hydrocarbons (PNAs)

PNAs are a group of chemicals that are formed during the incomplete burning of coal, oil, gas, wood, garbage, and other organic substances. PNAs are generated through human activities or can occur naturally. As such, these compounds are found throughout the environment in the air, water, and soil. Although there are over 100 different PNAs, EPA has only evaluated 17 of these compounds. Of these 17 PNAs, only seven are listed as probable human carcinogens (EPA Group B2).

In determining the toxicity values for these 17 PNAs, EPA uses two approaches. For noncarcinogens, EPA assesses each PNA individually. The noncarcinogenic toxicity values for each of these PNAs are listed below. For carcinogens, EPA has estimated order of magnitude potential potency factors for all carcinogenic PNAs except B[a]P. These potency factors are based on the potency of each PNA relative to B[a]P. This comparison to B[a]P was made since it is regarded as the most potent carcinogenic PNA.

To determine the toxicity values for the remaining carcinogenic PNAs, EPA suggests that the oral slope factor of B[a]P be multiplied by the potential potency factor for each corresponding PNA. The oral slope factor for B[a]P is 7.3E+00 $(mg/kg/day)^{-1}$. The order of

magnitude potential potency factors, and the resultant oral slope factors for the remaining carcinogenic PNAs are provided in the following text.

Acenaphthene

No information is available from human studies to determine the health effects resulting from exposure to specific levels of acenaphthene although inhalation and dermal exposure to mixtures of PNAs has been associated with the development of cancer in humans (ATSDR, Toxicologic Profile for Poly Aromatic Hydrocarbons, 1990). The levels and length of exposure to individual PNAs that result in human health effects can not be determined from the data that are currently available. Therefore, exposure levels that presumably cause human health effects have been estimated from experimental studies conducted in laboratory animals. Estimates of exposure that pose minimal risks to humans have been made where data are believed to be reliable. A minimal risk level (MRL) of 3.6 ppm in food for short-term human exposure (less than or equal to 14 days) has been estimated for PNAs in general. This estimated MRL is based on experimental studies in which laboratory animals were fed benzo[a]pyrene. Short-term exposure of mice to benzo[a]pyrene in the diet caused birth defects. Long-term (6 months) exposure of mice resulted in adverse effects on the liver and blood. Adjustments to reflect human variability and, where appropriate, the uncertainty of extrapolating from animals to humans have been made. The MRL provides a basis for comparison with levels that people might encounter in food. Exposure of humans to levels of PNAs below the estimated MRL is not expected to result in harmful (noncancer) health effects (ATSDR, Toxicological Profile for Polyaromatic Hydrocarbons, 1990). It should be recognized that uncertainties are associated with use of MRLs, particularly with respect to PNAs since estimates were based on data obtained with benzo[a]pyrene. It is well known that there are differences between different PNAs with regard to metabolism and, therefore, there may be significant toxicologic differences. MRLs have not been estimated for other routes of exposure (ATSDR, Toxicological Profile for Polyaromatic Hydrocarbons, 1990).

An oral RfD of 6.0E-02 mg/kg-day is listed in IRIS for acenaphthene. This value is based on a subchronic study conducted in mice. Mice were gavaged daily with 0, 175, 350, or 700

mg/kg-day acenaphthene for 90 days. Results from the study indicated no treatment-related effects on survival, clinical signs, body weight changes, food intake, or opthalmological alterations. However, dose-related liver weight changes accompanied by microscopic alterations (cellular hypertrophy) were noted in both mid- and high-dose groups. Significant increases in cholesterol levels were observed in high-dose males and mid- and high-dose females. A NOAEL of 175 mg/kg-day and a LOAEL of 350 mg/kg-day were established.

An uncertainty factor of 3000 was applied to account for inter- and intra-species variability (10x each), less than chronic duration of the study (10x), and the lack of adequate data in a second species and reproductive/developmental data (3x). A low confidence rating was given for the RfD because of the lack of supporting chronic toxicity and developmental/reproductive data. HEAST lists a subchronic oral RfD of 6.0E-01 mg/kg-day. Currently there is no data regarding the potential carcinogenicity of acenaphthene.

Acenapthylene

No information is available from human studies to determine the health effects resulting from exposure to specific levels of acenapthylene although inhalation and dermal exposure to mixtures of PNAs has been associated with the development of cancer in humans (ATSDR, Toxicologic Profile for Poly Aromatic Hydrocarbons, 1990).

The levels and length of exposure to individual PNAs that result in human health effects can not be determined from the data that are currently available. Therefore, exposure levels that presumably cause human health effects have been estimated from experimental studies conducted in laboratory animals. Estimates of exposure that pose minimal risks to humans have been made where data are believed to be reliable. A minimal risk level (MRL) of 3.6 ppm in food for short-term human exposure (less than or equal to 14 days) has been estimated for PNAs in general. This estimated MRL is based on experimental studies in which laboratory animals were fed benzo[a]pyrene. Short-term exposure of mice to benzo[a]pyrene in the diet caused birth defects. Long-term (6 months) exposure of mice resulted in adverse effects on the liver and blood.

Adjustments to reflect human variability and, where appropriate, the uncertainty of extrapolating from animals to humans have been made. The MRL provides a basis for comparison with levels that people might encounter in food. Exposure of humans to levels of PNAs below the estimated MRL is not expected to result in harmful (noncancer) health effects (ATSDR, Toxicological Profile for Polyaromatic Hydrocarbons, 1989). It should be recognized that uncertainties are associated with use of MRLs, particularly with respect to PNAs since estimates were based on data obtained with benzo[a]pyrene. It is well known that there are differences between different PNAs with regard to metabolism and, therefore, there may be significant toxicologic differences. MRLs have not been estimated for other routes of exposure (ATSDR, Toxicological Profile for Polyaromatic Hydrocarbons, 1990).

EPA has not developed an RfD for acenaphthylene but a risk assessment for this substance is uncer review by an EPA work group. EPA has listed acenaphthylene as Group D - Not Classifiable as to Human Carcinogenicity. This classification is based on a lack of human data and inadequate data from animal bioassays. Acenaphthylene yielded positive results in a *Salmonella typhimurium* forward mutation assay but was not positive in *Salmonella typhimurium* TA98 and TA100 in the presence of hepatic homogenates.

Benzo[a]Anthracene

No information is available about specific levels of benzo[a]anthracene (B[a]A) that result in harmful effects in humans after inhalation, oral, or dermal exposure. Two studies exist which indicate that B[a]A, when administered to animals by gavage, results in the development of stomach tumors. While these studies were flawed and inadequate for the development of significant human exposure levels, they do provide tentative evidence for oral carcinogenicity. B[a]A has been shown to suppress the sebaceous glands in mouse skin following topical application. However, these studies failed to employ controls and, therefore, definitive conclusions concerning the dermal toxicity of B[a]A cannot be made (ATSDR, 1990).

It has been demonstrated experimentally that B[a]A induces skin tumors in mice receiving 0.34 mg/kg or more when applied to the skin for 50 weeks. No information linking human exposure to B[a]A and cancer is available. However, reports of exposure to mixtures of polyaromatic hydrocarbons (PNAs) containing B[a]A and the induction of cancer in humans provides some support for the potential carcinogenicity of this compound.

USEPA has not developed an oral RfD or an inhalation RfC for B[a]A. Toxicity values were not calculated to evaluate the noncarcinogenic effects of B[a]A, as no methodology firmly founded on scientific basis exists for such calculations.

USEPA has listed B[a]A as a Group B2 - Probable Human Carcinogen. USEPA has not published a slope factor for B[a]A at this time. To evaluate the potential carcinogenic effects of B[a]A, an oral slope factor was calculated using the interim methodology described in the Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons (USEPA, 1993). The basis for the calculation was the health-based potential potency factor of 0.1 for B[a]A, which is an estimated order of magnitude of the potential potency of B[a]A relative to the potency of benzo[a]pyrene (B[a]P). A slope factor of 7.3 E-01 $(mg/kg/day)^{-1}$ was derived by multiplying the slope factor of B[a]P (7.3E+00 $[mg/kg/day]^{-1}$) by the potential potency factor for B[a]A.

References

Agency for Toxic Substances and Disease Registry (ATSDR). *Toxicological Profile for Benzo(A)Anthracene*, 1990.

USEPA, 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. July, 1993.

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Benzo[a]Pyrene

No information is available in the current literature concerning the levels of benzo[a]pyrene (B[a]P) which cause harmful effects in humans following inhalation, ingestion, or dermal exposure. Short- and long-term exposures to B[a]P (120 mg/kg/day for up to 6 months) caused death when ingested by animals. Deaths appeared to be due to bone marrow suppression. Offspring of animals fed 10 mg/kg/day B[a]P (or higher) during pregnancy had lower than normal birth weights and developmental/reproductive aberrations (e.g., alterations in gonadal development; decreased fertility; increased incidence of sterility). Reports on the effects of B[a]P following short-term dermal exposures in animals and intermediate exposures in humans suggest that B[a]P has deleterious effects on the skin. However, the studies failed to employ control groups and, therefore, conclusions about the dermal toxicity of B[a]P currently cannot be made (ATSDR, 1990).

The induction of cancer appears to be the key end point of toxicity following intermediate and long-term exposure to B[a]P by inhalation, ingestion, and dermal exposure since lower doses are required to induce tumors than other end points of toxicity. Experimental studies have demonstrated the ability of B[a]P to induce respiratory tract tumors in hamsters following long-term (lifetime) exposure to B[a]P as an aerosol at concentrations above 9.5 mg/m^3. Mice receiving B[a]P in the diet for 110 days (5.2 mg/kg/day) developed excess forestomach tumors. Long-term dermal exposure (1 μg/day) studies in animals have demonstrated the ability of B[a]P to induce skin tumors. No information correlating inhalation or dermal exposure of humans to B[a]P and cancer is available, although reports of lung and skin tumors in individuals exposed to mixtures of PNAs containing B[a]P lend some support for its carcinogenic potential.

USEPA has not developed an oral RfD for B[a]P. Toxicity values were <u>not</u> calculated to evaluate the noncarcinogenic effects of B[a]P, as no methodology firmly founded on scientific basis exists for such calculations.

USEPA has classified B[a]P as Group B2 - Probable Human Carcinogen. IRIS lists an oral slope factor for B[a]P as 7.30E+00 $(mg/kg/day)^{-1}$. Human data specifically linking B[a]P to

carcinogenic effects are lacking. However, there are numerous animal studies in many species that indicate that B[a]P is carcinogenic following administration by several routes.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1990) Toxicological Profile for Benzo(a)Pyrene. U.S. Dept. of Health and Human Services, Atlanta, GA.

Benzo[b]Fluoranthene

No information is available in the current literature concerning the levels of benzo[b]fluoranthene (B[b]F) which cause harmful effects in humans following inhalation, ingestion, or dermal exposure although inhalation and dermal exposure to mixtures of PNAs (including B[b]F) has been associated with the development of cancer in humans (ATSDR, 1990).

The levels and length of exposure to individual PNAs that result in human health effects cannot be determined from the data that are currently available. Therefore, exposure levels that presumably cause human health effects have been estimated from experimental studies conducted in laboratory animals. Estimates of exposure that pose minimal risks to humans have been made where data are believed to be reliable.

A minimal risk level of 3.6 ppm in food for short-term human exposure (less than or equal to 14 days) has been estimated for PNAs in general. This estimated minimum risk level (MRL) is based on experimental studies in which laboratory animals were fed B[a]P. Short-term exposure of mice to B[a]P in the diet caused birth defects. Long-term (6 months) exposure of mice resulted in adverse effects on the liver and blood. Adjustments to reflect human variability and, where appropriate, the uncertainty of extrapolating from animals to humans have been made. The MRL provides a basis for comparison with levels that people might encounter in food. Exposure of humans to levels of PNAs below the estimated MRL is not expected to result in harmful (noncancer) health effects (ATSDR, 1989).

It should be recognized that uncertainties are associated with use of MRLs, particularly with respect to PNAs since estimates were based on data obtained with B[a]P. It is well known that there are differences between different PNAs with regard to metabolism and, therefore, significant toxicologic difference may occur. MRLs have not been estimated for other routes of exposure (ATSDR, 1990).

No information is available on the effects of B[b]F in laboratory animals following exposure by inhalation, although B[b]F elicits respiratory tract tumors in rats following intratracheal instillation. B[b]F is carcinogenic following intermediate dermal exposure. Mice receiving doses of 2.9 mg/kg and higher, three times weekly (equivalent to an average daily dose of 1.2 mg/kg/day) developed an excess of malignant skin tumors when B[b]F was applied to the skin for up to one year. No information correlating inhalation or dermal exposure to B[b]F and cancer induction in humans is available, but reports of cancer among individuals exposed by inhalation or dermally to mixtures of PNAs containing B[b]F provide qualitative support for the carcinogenicity of this compound.

USEPA has not developed an oral RfD for B[b]F. Toxicity values were <u>not</u> calculated to evaluate the noncarcinogenic effects of B[a]P, as no methodology firmly founded on scientific basis exists for such calculations.

USEPA has listed B[b]F as a Group B2 - Probable Human Carcinogen. While there are no human data that specifically link exposure to B[b]F with cancer, it is a component of mixtures that are associated with human cancer. Supporting data include the production of tumors in mice after lung implantation, intraperitoneal or subcutaneous injection and skin painting with B[b]F. USEPA has not published a slope factor for B[b]F at this time. An oral slope factor of 7.3E-01 $(mg/kg/day)^{-1}$ was calculated by multiplying the slope factor for B[a]P by the relative potency factor of 0.1 for B[b]F (USEPA, 1993).

References

Agency for Toxic Substances and Disease Registry (ATSDR). <u>Toxicological Profile for Poly Aromatic Hydrocarbons</u>, 1989.

Agency for Toxic Substances and Disease Registry (ATSDR). Toxicologic Profile for Poly Aromatic Hydrocarbons, 1990.

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Benzo(g,h,i)Perylene

No information is available in the current literature concerning the level of benzo(g,h,i)perylene that results in harmful effects in humans following inhalation, ingestion, or dermal exposure although inhalation and dermal exposure to mixtures of PNAs has been associated with the development of cancer in humans (ATSDR, 1990).

The levels of length of exposure to individual PNAs that result in human health effects can not be determined from the data that are currently available. Therefore, exposure levels that presumably cause human health effects have been estimated from experimental studies conducted in laboratory animals. Estimates of exposure that pose minimal risks to humans have been made where data are believed to be reliable. A minimal risk level (MRL) of 3.6 ppm in food for short-term human exposure (less than or equal to 14 days) has been estimated for PNAs in general. This estimated MRL is based on experimental studies in which laboratory animals were fed benzo(a)pyrene. Short-term exposure of mice to benzo(a)pyrene in the diet caused birth defects. Long-term (6 months) exposure of mice resulted in adverse effects on the liver and blood. Adjustments to reflect human variability and, where appropriate, the uncertainty of extrapolating from animals to humans have been made. The MRL provides a basis for comparison with levels that people might encounter in food. Exposure of humans to levels of PNAs below the estimated MRL is not expected to result in harmful (noncancer) health effects. It should be recognized that uncertainties are associated with use of MRLs, particularly with respect to PNAs since estimates were based on data obtained with benzo(a)pyrene. It is well known that there are differences between different PNAs with regard to metabolism and, therefore, there may be significant toxicologic differences (ATSDR, 1990).

EPA has not developed an oral RfD for benzo(g,h,i)perylene. Toxicity values were not calculated to evaluate noncarcinogenic effects of benzo(g,h,i)perylene as no methodology firmly founded on scientific basis exist for such calculations.

EPA has classified benzo(g,h,i)perylene as a Group D - Not Classifiable as to Human Carcinogenicity. This classification precludes quantitative evaluation of toxicity. Therefore, no slope factor is available.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1990) Toxicological Profile for Polyaromatic Hydrocarbons. U.S. Dept. of Health and Human Services, Atlanta, GA.

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Benzo[k]Fluoranthene

No information is available in the current literature concerning the levels of benzo[k]fluoranthene (B[k]F) which cause harmful effects in humans although inhalation and dermal exposure to mixtures of PNAs has been associated with the development of cancer in humans (ATSDR, 1990).

The levels and length of exposure to individual PNAs that result in human health effects cannot be determined from the data that are currently available. Therefore, exposure levels that presumably cause human health effects have been estimated from experimental studies conducted in laboratory animals. Estimates of exposure that pose minimal risks to humans have been made where data are believed to be reliable. A MRL of 3.6 ppm in food for short-term human exposure (less than or equal to 14 days) has been estimated for PNAs in general. This estimated MRL is based on experimental studies in which laboratory animals were fed B[a]P. Short-term exposure of mice to B[a]P in the diet caused birth defects. Long-term (6 months) exposure of mice resulted in adverse effects on the liver and blood. Adjustments to reflect human variability and,

where appropriate, the uncertainty of extrapolating from animals to humans have been made. The MRL provides a basis for comparison with levels that people might encounter in food. Exposure of humans to levels of PNAs below the estimated MRL is not expected to result in harmful (noncancer) health effects (ATSDR, 1990).

It should be recognized that uncertainties are associated with use of MRLs, particularly with respect to PNAs since estimates were based on data obtained with B[a]P. It is well known that there are differences between different PNAs with regard to metabolism and, therefore, significant toxicologic differences may occur. MRLs have not been estimated for other routes of exposure (ATSDR, 1990).

USEPA has not developed an oral RfD for B[k]F. Toxicity values were not calculated to evaluate the noncarcinogenic effects of B[a]P, as no methodology firmly founded on scientific basis exists for such calculations.

USEPA has listed B(k)F as a Group B2 -- Probable Human Carcinogen. USEPA has not published a slope factor for B[k]F at this time. An oral slope factor of 7.3 E-02 $(mg/kg/day)^{-1}$ was calculated by multiplying the slope factor for B[a]P by the relative potency factor of 0.01 for B[k]F.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1990) Toxicological Profile for Poly Aromatic Hydrocarbons U.S. Dept. of Health and Human Services, Atlanta, GA.

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Chrysene

No information is available in the current literature concerning the level of chrysene (if any) that results in harmful effects in humans following inhalation, ingestion, or dermal exposure

although inhalation and dermal exposure to mixtures of PNAs has been associated with the development of cancer in humans (ATSDR, *Toxicologic Profile for Poly Aromatic Hydrocarbons*, 1990).

The levels and length of exposure to individual PNAs that result in human health effects can not be determined from the data that are currently available. Therefore, exposure levels that presumably cause human health effects have been estimated from experimental studies conducted in laboratory animals. Estimates of exposure that pose minimal risks to humans have been made where data are believed to be reliable. A minimal risk level (MRL) of 3.6 ppm in food for short-term human exposure (less than or equal to 14 days) has been estimated for PNAs in general. This estimated MRL is based on experimental studies in which laboratory animals were fed benzo[a]pyrene. Short-term exposure of mice to benzo[a]pyrene in the diet caused birth defects. Long-term (6 months) exposure of mice resulted in adverse effects on the liver and blood. Adjustments to reflect human variability and, where appropriate, the uncertainty of extrapolating from animals to humans have been made. The MRL provides a basis for comparison with levels that people might encounter in food. Exposure of humans to levels of PNAs below the estimated MRL is not expected to result in harmful (noncancer) health effects (ATSDR, *Toxicological Profile for Polyaromatic Hydrocarbons*, 1990). It should be recognized that uncertainties are associated with use of MRLs, particularly with respect to PNAs since estimates were based on data obtained with benzo[a]pyrene. It is well known that there are differences between different PNAs with regard to metabolism and, therefore, there may be significant toxicologic differences. However, based on the electron density associated with the molecule, chrysene would be expected to behave in a manner similar to B[a]P with respect to metabolism. MRLs have not been estimated for other routes of exposure (ATSDR, "Toxicological Profile for Polyaromatic Hydrocarbons", 1990).

Experimental data indicates that skin cancer develops in mice exposed dermally. No information is available regarding short-term dermal exposure of animals to chrysene but chrysene is carcinogenic in mice following long-term (life-time) dermal exposure. Information correlating human dermal exposure to chrysene and the induction of cancer is currently unavailable. However,

reports of skin tumors among individuals exposed to mixtures of polyaromatic hydrocarbons (PNAs), including chrysene, does provide some support for chrysene's carcinogenic potential.

EPA has not developed an oral RfD for chrysene.

EPA has listed chrysene as a Group B2 -- Probable Human Carcinogen. EPA has not published a slope factor for chrysene at this time. An oral slope factor of 7.3 E-03 $(mg/kg\text{-}day)^{-1}$ was calculated by multiplying the slope factor for benzo(a)pyrene by the relative potency factor of 0.001 for chrysene (USEPA, 1991).

Dibenzo(a,h)anthracene

No information is available in the current literature concerning the levels of Dibenzo(a,h)anthracene which cause harmful effects in humans although inhalation and dermal exposure to mixtures of PNAs has been associated with the development of cancer in humans (ATSDR, 1990).

The levels and length of exposure to individual PNAs that result in human health effects cannot be determined from the data that are currently available. Therefore, exposure levels that presumably cause human health effects have been estimated from experimental studies conducted in laboratory animals. Estimates of exposure that pose minimal risks to humans have been made where data are believed to be reliable. A MRL of 3.6 ppm in food for short-term human exposure (less than or equal to 14 days) has been estimated for PNAs in general. This estimated MRL is based on experimental studies in which laboratory animals were fed B[a]P. Short-term exposure of mice to B[a]P in the diet caused birth defects. Long-term (6 months) exposure of mice resulted in adverse effects on the liver and blood. Adjustments to reflect human variability and, where appropriate, the uncertainty of extrapolating from animals to humans have been made. The MRL provides a basis for comparison with levels that people might encounter in food. Exposure of humans to levels of PNAs below the estimated MRL is not expected to result in harmful (noncancer) health effects (ATSDR, 1990).

It should be recognized that uncertainties are associated with use of MRLs, particularly with respect to PNAs since estimates were based on data obtained with B[a]P. It is well known that there are differences between different PNAs with regard to metabolism and, therefore, significant toxicologic differences may occur. MRLs have not been estimated for other routes of exposure (ATSDR, 1990).

USEPA has not developed an oral RfD for Dibenzo(a,h)anthracene. Toxicity values were not calculated to evaluate the noncarcinogenic effects of Dibenzo(a,h)anthracene, as no methodology firmly founded on scientific basis exists for such calculations.

USEPA has listed Dibenzo(a,h)anthracene as a Group B2 -- Probable Human Carcinogen. This classification is based on the mutagenic potential of dibenzo(a,h)anthracene in several mutagenic assays. Also, dibenzo(a,h)anthracene has been shown to produce carcinomas in mice following oral or dermal exposure. An oral slope factor for this compound was calculated as 7.3 E+0 by multiply the oral slope factor of B[a]P by the potential potency factor of 1.0 for dibenzo(a,h)anthracene.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1990) Toxicological Profile for Poly Aromatic Hydrocarbons U.S. Dept. of Health and Human Services, Atlanta, GA.

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Fluorene

No information is available in the current literature concerning the level of fluorene that results in harmful effects in humans following inhalation, ingestion, or dermal exposure although inhalation and dermal exposure to mixtures of PNAs has been associated with the development of cancer in humans (ATSDR, *Toxicological Profile for Polyaromatic Hydrocarbons*, 1990).

The levels and length of exposure to individual PNAs that result in human health effects can not be determined from the data that are currently available. Therefore, exposure levels that presumably cause human health effects have been estimated from experimental studies conducted in laboratory animals. Estimates of exposure that pose minimal risks to humans have been made where data are believed to be reliable. A minimal risk level (MRL) of 3.6 ppm in food for short-term human exposure (less than or equal to 14 days) has been estimated for PNAs in general. This estimated MRL is based on experimental studies in which laboratory animals were fed benzo[a]pyrene. Short-term exposure of mice to benzo[a]pyrene in the diet caused birth defects. Long-term (6 months) exposure of mice resulted in adverse effects on the liver and blood. Adjustments to reflect human variability and, where appropriate, the uncertainty of extrapolating from animals to humans have been made. The MRL provides a basis for comparison with levels that people might encounter in food. Exposure of humans to levels of PNAs below the estimated MRL is not expected to result in harmful (noncancer) health effects (ATSDR, *Toxicological Profile for Polyaromatic Hydrocarbons*, 1990). It should be recognized that uncertainties are associated with use of MRLs, particularly with respect to PNAs since estimates were based on data obtained with benzo[a]pyrene. It is well known that there are differences between different PNAs with regard to metabolism and, therefore, there may be significant toxicologic differences. MRLs have not been estimated for other routes of exposure (ATSDR, *Toxicological Profile for Polyaromatic Hydrocarbons*, 1990).

An oral RfD of 4.0E-02 mg/kg-day is listed in IRIS for fluorene. This value is based on a subchronic study conducted in mice. Mice were exposed to 0, 125, 250, or 500 mg/kg-day fluorene suspended in corn oil by gavage for 13 weeks. Increased salivation and hypoactivity were observed in all treated animals. Labored respiration and ptosis (drooping eyelids) were noted in the 500 mg/kg-day dose group. A significant decrease in red blood cell count and packed cell volume were observed in females treated with 250 mg/kg-day fluorene and in both sexes at the 500 mg/kg-day dose. Decreased hemoglobin and increased total serum bilirubin levels were also observed in the 500 mg/kg-day dose group. A significant decreasing trend in BUN (blood urea nitrogen) and a significant increasing trend in total serum bilirubin were observed in both males and females at the highest dose (500 mg/kg-day). A significant increase in relative liver weight at all doses and a

significant increase in absolute liver weight was noted at the 250 and 500 mg/kg-day dose. An increase in absolute and relative spleen and kidney weight was observed in males and females exposed to 500 mg/kg-day and in females exposed to 500 mg/kg-day. The increases in absolute liver and spleen weights were accompanied by histopathological increases in the amounts of hemosiderin in the spleen and kupffer cells in the liver. A LOAEL of 250 mg/kg-day and a NOAEL of 125 mg/kg-day was established.

An uncertainty factor of 3000 was used to account for use of a subchronic study (10x), inter- and intra-species variability (10x each), and for lack of adequate toxicity data in a second species and reproductive/developmental data (3x). Low confidence was placed on the RfD due to the fact that reproductive, developmental, and chronic toxicity have not been evaluated following oral exposure to fluorene. Additionally, a NOAEL was not identified. HEAST lists a subchronic RfD of 4.0E-01 mg/kg-day.

EPA classifies fluorene as Group D--Not Classifiable as to Human Carcinogenicity. This classification is based on a lack of human data and inadequate data from animal bioassays.

Indeno[1,2,3-cd]Pyrene

No information is available in the current literature concerning the level of indeno[1,2,3]pyrene that results in harmful effects in humans following inhalation, ingestion, or dermal exposure although inhalation and dermal exposure to mixtures of PNAs has been associated with the development of cancer in humans (ATSDR, 1990).

The levels and length of exposure to individual PNAs that result in human health effects can not be determined from the data that are currently available. Therefore, exposure levels that presumably cause human health effects have been estimated from experimental studies conducted in laboratory animals. Estimates of exposure that pose minimal risks to humans have been made where data are believed to be reliable. A minimal risk level (MRL) of 3.6 ppm in food for short-term human exposure (less than or equal to 14 days) has been estimated for PNAs in

general. This estimated MRL is based on experimental studies in which laboratory animals were fed benzo[a]pyrene. Short-term exposure of mice to benzo[a]pyrene in the diet caused birth defects. Long-term (6 months) exposure of mice resulted in adverse effects on the liver and blood. Adjustments to reflect human variability and, where appropriate, the uncertainty of extrapolating from animals to humans have been made. The MRL provides a basis for comparison with levels that people might encounter in food. Exposure of humans to levels of PNAs below the estimated MRL is not expected to result in harmful (noncancer) health effects (ATSDR, 1990). It should be recognized that uncertainties are associated with use of MRLs, particularly with respect to PNAs since estimates were based on data obtained with benzo[a]pyrene. It is well known that there are differences between different PNAs with regard to metabolism and, therefore, there may be significant toxicologic differences (ATSDR, 1990).

EPA has not developed an oral RfD for indeno[1,2,3]pyrene. Toxicity values were not calculated to evaluate noncarcinogenic effects of indeno(1,2,3-cd)pyrene, as no methodology firmly founded on scientific basis exists for such calculations.

EPA has listed indeno[1,2,3]pyrene as a Group B2 - Probable Human Carcinogen. Insufficient human data as to the potential carcinogenicity of indeno[1,2,3]pyrene was available but the data from animal bioassays was considered sufficient for this classification. Indeno[1,2,3]pyrene produced tumors in mice following lung implants, subcutaneous injection, and dermal exposure. Indeno[1,2,3]pyrene also tested positive in bacterial gene mutation assays. However, EPA has not published a slope factor for indeno[1,2,3]pyrene at this time. An oral slope factor of 7.3 E-01 $(mg/kg\text{-}day)^{-1}$ was calculated by multiplying the slope factor for benzo(a)pyrene by the relative potency factor of 0.1 for indeno[1,2,3]pyrene.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1990) Toxicological Profile for Polyaromatic Hydrocarbons. U.S. Dept. of Health and Human Services, Atlanta, GA.

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Naphthalene

Exposure to naphthalene for short or long periods of time may lead to hemolytic anemia, the breakdown of the red blood cells. Nausea, vomiting, diarrhea, kidney damage, jaundice, and liver damage are some other commonly found effects. Ingestion or inhalation of naphthalene may also lead to cataracts. Laboratory animals ingesting or inhaling naphthalene have exhibited effects on the blood, kidneys, and liver, and in some animals cataracts were seen. Carcinogenicity has not been seen in animals or in humans. Reproductive effects are unknown, however, pregnant women exposed to naphthalene deliver infants with propensity to develop hemolytic anemia.

IRIS did not list an oral RfD for naphthalene; this value is currently under review by a work group. A chronic oral RfD of 4.0E-02 mg/kg-day is listed in HEAST. HEAST also lists the subchronic RfD as 4.0E-02 mg/kg-day. These values were based on a study in which rats were gavaged with 50 mg/kg-day naphthalene, 5 days a week, for 13 weeks (converted to 37.5 mg/kg-day). The critical effect observed was decreased body weight gain. HEAST listed an uncertainty factor of 1000 for the subchronic RfD and 10,000 for the chronic oral RfD.

EPA classifies naphthalene as Group D - Not Classifiable as to Human Carcinogenicity. This classification reflects a lack of human carcinogenicity data and inadequate data from animal bioassays.

Phenanthrene

No information is available in the current literature concerning the level of phenanthrene that results in harmful effects in humans following inhalation, ingestion, or dermal exposure although inhalation and dermal exposure to mixtures of PNAs has been associated with the development of cancer in humans (ATSDR, *Toxicologic Profile for Polyaromatic Hydrocarbons*, 1990).

The levels and length of exposure to individual PNAs that result in human health effects cannot be determined from the data that are currently available. Therefore, exposure levels that presumably cause human health effects have been estimated from experimental studies conducted in laboratory animals.

Estimates of exposure that pose minimal risks to humans have been made where data are believed to be reliable. A MRL of 3.6 ppm in food for short-term human exposure (less than or equal to 14 days) has been estimated for PNAs in general. This estimated MRL is based on experimental studies in which laboratory animals were fed benzo[a]pyrene (B[a]P). Short-term exposure of mice to B[a]P in the diet caused birth defects. Long-term (6 months) exposure of mice resulted in adverse effects on the liver and blood. Adjustments to reflect human variability and, where appropriate, the uncertainty of extrapolating from animals to humans have been made. The MRL provides a basis for comparison with levels that people might encounter in food. Exposure of humans to levels of PNAs below the estimated MRL is not expected to result in harmful (noncancer) health effects (ATSDR, *Toxicological Profile for Polyaromatic Hydrocarbons*, 1990).

It should be recognized that uncertainties are associated with use of MRLs, particularly with respect to PNAs since estimates were based on data obtained with B[a]P. It is well known that there are differences between different PNAs with regard to metabolism and, therefore, there may be significant toxicologic differences. (ATSDR, *Toxicological Profile for Polyaromatic Hydrocarbons*, 1990).

An oral RfD for phenanthrene has not been established. USEPA classifies phenanthrene as Group D - Not Classifiable as to Human Carcinogenicity. This classification reflects a lack of human carcinogenicity data and inadequate data from a single gavage study in rats and skin painting and injection studies in mice. Classification of a chemical as Group D precludes quantitative toxicity assessment. Therefore, no slope factor for phenanthrene is listed in either IRIS or HEAST.

G.36 1,1,2,2-Tetrachloroethane

Respiratory failure and unconsciousness occurs after acute inhalation of 1,1,2,2-tetrachloroethane; however, histological changes in the lungs have not been seen in lab animals. Humans occupationally exposed to the compound has complained of nausea, loss of appetite, abdominal cramping, vomiting, and loss of weight. Data in animals does not substantiate this effect though.

Minor histological damage in the liver of rats treated by oral gavage for a subchronic duration was seen as well as minor inflammation of the kidneys. A highly significant dose-related trend in the incidence of hepatocellular carcinomas in mice has been observed. Dermal exposure lead to karyopyknosis and pseudo eosinophilic infiltration in guinea pigs and dermal necrosis in rabbits. No other dermal studies were located that discussed the systemic effects of dermal application of 1,1,2,2-tetrachloroethane (ATSDR, *Toxicological Profile for 1,1,2,2-Tetrachloroethane*, 1989).

1,1,2,2-Tetrachloroethane is classified as a Group C--Possible Human Carcinogen. EPA based this assignment on an increased incidence of hepatocellular carcinomas in mice. There is no human carcinogenicity data. No oral RfDs are provided by IRIS or HEAST. IRIS indicates that this substance is under review by an EPA work group. An oral slope factor of 2E-01 $(mg/kg\text{-}day)^{-1}$ is provided on IRIS which also gives an inhalation unit risk factor of 5.8E-05 $(\mu g/m^3)^{-1}$, which was calculated from oral exposure.

G.37 Tetrachloroethylene

Tetrachloroethylene is a man-made chemical used for dry cleaning fabrics, metal-degreasing, for making other chemicals, and in some consumer products such as auto brake quieters and cleaners, suede protectors, water repellents, silicone lubricants, and belt lubricants. It is a liquid at room temperature, is nonflammable, and evaporates readily producing a sharp, sweet odor. Tetrachloroethylene reaches the environment when it is released from industrial or dry cleaning

operations, or from waste sites. Tetrachloroethylene is found more often in the air than in water, soil, or sediment. Those people who work in areas where tetrachloroethylene is used are more likely to be exposed to it than those who don't work in those areas (ATSDR 1993).

Exposure to tetrachloroethylene by inhalation has resulted in respiratory tract irritation, liver injury, and kidney damage in humans. The central nervous system (CNS) is also affected by tetrachloroethylene inhalation. Acute inhalation of the chemical results in reversible effects such as mood and behavioral changes, impairment of coordination, anesthetic effects, and headache. Long-term exposure to tetrachloroethylene may cause persistent CNS symptoms such as memory and concentration impairment. Inhalation of tetrachloroethylene may adversely affect female reproduction. Oral ingestion of tetrachloroethylene may affect the liver in humans, although this effect is not well documented. CNS effects observed after oral ingestion of tetrachloroethylene are similar to those seen with inhalation exposure. Exposure to tetrachloroethylene vapors causes severe eye irritation at concentrations greater than 1,000 ppm. Chemical burns have been reported after prolonged (at least 5 hours) skin contact with tetrachloroethylene (ATSDR 1993).

Exposure to tetrachloroethylene by inhalation in animals has resulted in an increased susceptibility to respiratory infection in mice, liver injury, kidney damage, and CNS effects. Inhalation exposure may affect CNS development in animals. The liver is the principal target organ of tetrachloroethylene oral exposure in rats. The kidneys are also effected in animals exposed by oral ingestion (ATSDR 1993).

IRIS lists a chronic RfD for tetrachloroethylene of 1.0E-02 mg/mg/day. This value was derived from the results of a 6 week mouse gavage study in which hepatotoxicity in mice and weight gain in rats were the endpoints measured. The NOAEL for this study was determined to be 20 mg/kg/day (converted to 14mg/kg/day to adjust for a 5 days/week treatment schedule). The LOAEL determined for this study was determined to be 100 mg/kg/day (converted to 71 mg/kg/day to adjust for a 5 days/week treatment schedule) for this study. An uncertainty factor of 1000 was used for the derived RfD to account for intraspecies variability, interspecies variability, and extrapolation of a subchronic effect to its chronic equivalent. This confidence in this RfD value is

considered low. HEAST lists a subchronic RfD of 1.0E-01 for this chemical. An RfC is not available for tetrachloroethylene at this time.

Although no slope factors are available at this time from IRIS or HEAST, EPA Region III provides oral and inhalation slope factors of 5.2 E-2 and 2.0 E-3 (mg Kg/day)$^{-1}$, respectively. The inhalation slope factor was converted to an inhalation unit risk by using an adult body weight of 70 kg and inhalation rate of 20 m^3\day.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1993) Toxicological Profile for Tetrachloroethylene. U.S. Dept. of Health and Human Services, Atlanta, GA.

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G.38 Thallium

Thallium can affect the nervous system, lungs, liver, and kidneys if large amounts are ingested over short periods of time. Effects include temporary hair loss, vomiting, and diarrhea. Death may result if very large amounts are ingested (1 mg or greater). Chronic effects have not been determined. Animal reproductive organs, especially the testes, are damaged after drinking small amounts of thallium-contaminated water for 2 months. A minimal risk level of 0.003 ppm in water was derived from animal data from short-term exposure. MRLs provide a basis for comparison with levels that people might encounter in food or drinking water. Exposure to amounts below the MRL is not expected to cause harmful health effects (ATSDR, *Toxicological Profile for Thallium*, 1991).

Thallium forms complexes in solution with halogens, oxygen, and sulfur. The oral RfD for thallium sulfate is listed in IRIS as 8.0E-05 mg/kg/day. This value is based on a subchronic (90 day) oral study in which Sprague-Dawley rats were treated by gavage with 0, 0.01, 0.05, or 0.25 mg/kg/day. Dose-related increases in alopecia, lacrimation, and exophthalmos were observed throughout the study. Moderate dose-related changes were observed in blood chemistry parameters

(SGOT, LDH, sodium, and sugar levels). The highest dose of thallium sulfate (0.25 mg/kg/day) was considered the NOAEL (converted to 0.20 mg/kg/day). An uncertainty factor of 3000 was applied to the NOAEL to derive the RfD. This uncertainty further adjusts for intra- (10X) and interspecies (10X) variability, extrapolation of a subchronic effect level to a chronic level (10X), and a factor of 3 to account for lack of reproductive and chronic toxicity. The confidence level in the RfD is low because of uncertainties in the results and because supporting studies report that health effects result at doses slightly higher than the NOAEL.

Thallium sulfate is classified as Group D - Not Classifiable as to Human Carcinogenicity. This classification is based on a lack of carcinogenicity data in animals and humans.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1991) Toxicological Profile for Thallium. U.S. Dept. of Health and Human Services, Atlanta, GA.

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G.39 Toluene

Toluene has the ability to dissolve fats. As a result, it causes pain when it comes in contact with the eye. Damage to the skin may occur upon dermal contact as a result of scattered loss of epithelial cells and solution of some of the fats that occur in these cells. Factory workers handling organic solvents such as toluene have been reported to have low sperm counts, abnormal sperm and varying degrees of infertility (Thomas, 1991). Toluene has also been reported to cause a decrement of pulmonary function (FEV_1) (Gordon and Amdur, 1991).

A chronic oral RfD value of 2.0E-01 mg/kg-day is listed in IRIS. The subchronic oral RfD listed in HEAST is 2.0E-00 mg/kg-day. These values are based primarily on a subchronic gavage study in which rats were administered varying doses of toluene for 13 weeks. All animals

receiving the highest dose (5000 mg/kg) died within the first week. In males, absolute and relative weights of both the liver and kidney were significantly increased at doses greater than or equal to 625 mg/kg. Absolute and relative weights of the liver, kidney, and heart were significantly increased at doses greater than or equal to 1250 mg/kg in females. The NOAEL for this study was 312 mg/kg-day based on liver and kidney weight changes in male rats at 625 mg/kg. Because the exposure was for 5 days/week, this dose is converted to 223 mg/kg-day. The LOAEL was 625 mg/kg, which is 446 mg/kg-day when converted.

An uncertainty factor of 1000 was applied to derive the RfD to account for inter- and intraspecies extrapolations, for subchronic to chronic extrapolation and for limited reproductive and developmental toxicity data. The level of confidence in the oral RfD was medium. This rating reflects that a sufficient number of animals/sex were tested in six dose groups and that many parameters were studied, but that there was no reproductive study and that the oral studies were all subchronic. The chronic inhalation RfC of 4.0E-01 mg/m^3 has been verified according to the new interim methods for developing RfCs and is listed in IRIS. The subchronic inhalation RfC is listed in HEAST as 2.0E+00 mg/m^3.

USEPA has classified toluene as Group D--Not Classifiable as to Human Carcinogenicity. This classification reflects the lack of human carcinogenicity data and inadequate animal data. Therefore, no slope factor is listed.

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G.40 1,1,2-Trichloroethane

The only long-term inhalation study showed no increased mortality in laboratory animals. However, significance of the study is questionable because experimental methods and results were not described in sufficient detail. Intermediate to high levels of 1,1,2-trichloroethane vapors have resulted in increased liver enzymes and minor fatty changes in the liver.

One oral study showed an increased incidence of hepatocellular carcinomas and a significant increase in the occurrence of adrenal pheochromocytomas in mice. Dermal application appears to cause hydropic changes in the liver and erythema and edema (ATSDR, *Toxicological Profile for 1,1,2-Trichloroethane*, 1989).

IRIS gives a chronic oral RfD of 4E-03 mg/kg-day for 1,1,2-trichloroethane. HEAST provides a subchronic oral RfD of 4E-02 mg/kg-day. These values were derived from a subchronic drinking water study in where the critical effect was observed as changes in the clinical chemistry (i.e., increased liver enzymes). A medium confidence rating is given to the RfD because of the general lack of appropriate chronic study, and the lack of a NOAEL. IRIS indicates that the inhalation RfC is under review.

1,2,2-Trichloroethane is classified as a Group C--Possible Human Carcinogen. EPA has based this classification on the structural similarities between 1,1,2-trichloroethane and 1,2-dichloroethane, a probable human carcinogen, and due to the increased incidence in hepatocellular carcinomas and pheochromocytomas in mice. An oral slope factor of 5.7E-02 $(mg/kg\text{-}day)^{-1}$ is listed in IRIS as well as an inhalation unit risk factor of 1.6E-05 $(\mu g/m^3)^{-1}$. The inhalation unit risk factor was calculated from the oral exposure data.

G.41 Trichloroethene

Trichloroethene is a non-flammable, man-made, colorless liquid with an odor similar to ether or chloroform. It is primarily used as a solvent, especially for the purpose of removing grease from metal parts, and in the production of other chemicals. Trichloroethene reaches the environment mainly by evaporation or disposal from industrial facilities. Trichloroethene in water and soil may evaporate to the air. It will degrade in air in about a week to a chemical that may irritate the lungs. Trichloroethene in groundwater and surface water may also degrade, but when in soils, little of it will break down (ATSDR, 1992).

Inhalation of trichloroethene may result in adverse health effects. Deaths have been reported in humans that inhaled high concentrations of trichloroethene, although the concentrations and durations of exposure resulting in death have not been determined. Deaths have been reported in animals with acute, intermediate, and chronic exposures to trichloroethene. Cardiovascular, gastrointestinal, hematological, hepatic, renal, immunological, and neurological effects may result from inhalation exposure to trichloroethene. Inhalation of large quantities of trichloroethene may cause dizziness, sleepiness, and ultimately, loss of consciousness. Damage to the nerves of the face have been reported in people exposed to high levels of trichloroethene. Skin and eye irritation may result from contact with trichloroethene vapors (ATSDR, 1992).

Oral ingestion of high doses of trichloroethene may result in death, although only one documented case of death in humans has been reported. Other effects or oral ingestion of trichloroethene have not been well documented. Animal studies indicate that hematological, hepatic, renal. immunological, and neurological effects may result from trichloroethene ingestion (ATSDR, 1992).

Dermal contact with trichloroethene may result in skin irritation, burns, and rashes. It is not known whether dermal contact results in systemic adverse effects(ATSDR, 1992).

Neither IRIS or HEAST lists an oral RfD, inhalation RfD or inhalation RfC. Risk assessments are currently under review by an EPA work group for noncarcinogenic effects resulting from trichloroethene exposure. EPA Region III however, lists an oral RfD of 6.0E-3 mg/kg/day in its Risk-Based Concentration Table (USEPA, 1995).

The carcinogenicity of trichloroethene is under review. It has been reported that people who used water from a well contaminated with high concentrations of trichloroethene may have had an increased incidence of leukemia (ATSDR, 1992). IRIS nor HEAST list oral or inhalation slope factors for trichloroethene. In the EPA Region III Risk-Based Concentration Table, oral and inhalation slope factors are listed as 1.1E-2 and 6.0E-3 $(mg/kg/day)^{-1}$, respectively. The

inhalation slope factor was converted to an inhalation unit risk by using an adult body weight of 70 kg and an inhalation rate of 20 m^3/day.

References

ATSDR (Agency for Toxic Substances and Disease Registry). (1992). Draft Toxicological Profile for Trichloroethylene. U.S. Dept. for Health and Human Services, Atlanta, GA.

TRICHLEE.REV
7/95

G.42 Vinyl Chloride

Vinyl chloride is a colorless vapor. It has a slightly sweet odor and can exist as a liquid under high pressure. Almost all vinyl chloride is man-made for use in the plastics industry to make polyvinyl chloride. Vinyl chloride was used in the past as a coolant and propellant, but is no longer used for those purposes. Most vinyl chloride found in the environment was released into it by the plastics industry. It may also be found in the environment because it can be a breakdown product of other chemicals and is found in tobacco smoke (ATSDR, 1992).

Vinyl chloride may adversely affect human health after inhalation, oral, and dermal exposure. Deaths have occurred in humans exposed by inhalation to high levels of vinyl chloride. Deaths also occurred in animals after brief exposure to high concentrations of vinyl chloride and decreased longevity was observed at lower concentrations for intermediate- and chronic-durations inhalation studies. Adverse systemic effects caused by vinyl chloride inhalation in humans and animals include respiratory, cardiovascular, hematological, musculoskeletal, hepatic, dermal, ocular, immunological, neurological, and reproductive. Evidence that vinyl chloride inhalation adversely affects human developmental and reproduction have not been conclusive. Adverse renal and reproductive effects have been observed in animals after vinyl chloride inhalation. Adverse developmental effects were observed in animals exposed to vinyl chloride by inhalation at concentrations toxic to maternal animals(ATSDR, 1992).

No studies regarding the effects of oral exposure of humans to vinyl chloride have been found. Oral exposure of animals to vinyl chloride resulted in decreased longevity with chronic ingestion, adverse hematological, hepatic, and dermal effects, and cancer (ATSDR, 1992).

Dermal exposure to liquid vinyl chloride by humans has resulted in second degree burns and numbing of the skin. No studies were located on the adverse effects of dermal exposure to liquid vinyl chloride in animals (ATSDR, 1992).

No RfD or RfC is available in IRIS or HEAST for vinyl chloride.

Vinyl chloride is classified as a Group A - Human Carcinogen. It has been found to be genotoxic and carcinogenic with inhalation exposure and oral exposure (ATSDR, 1992). HEAST lists an oral slope factor of 1.9E0 and an inhalation unit risk of 8.4E-5 $(\mu g/m3)^{-1}$ for vinyl chloride. The oral slope factor was based on the results of a 1001 day feeding study in rats measuring lung and liver tumors. The inhalation unit risk was based on the results of a 1 year intermittent administration of vinyl chloride to rats measuring liver tumors.

References

ATSDR (Agency for Toxic Substances and Disease Registry) (1992) Toxicological Profile for Vinyl Chloride. U.S. Dept. of Health and Human Services, Atlanta, GA.

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7/95

G.43 Xylenes

Short-term exposure of humans to high levels of xylene or chemical mixtures containing xylene causes irritation of skin, eyes, nose, and throat, increased reaction time to visual stimuli, impaired memory/stomach discomfort, and possible changes in the liver and kidneys. Short-term exposure of individuals to very high concentrations of xylene can result in death. Both short- and long-term exposure of humans to xylenes can also cause a number of effects on the nervous system such as headaches, lack of muscle coordination, dizziness, confusion, and loss of balance (ATSDR, 1990).

Information obtained from experimental studies conducted on animals is not adequate to determine whether xylene causes human cancer. However, studies on animals indicate that xylene may cause increased numbers of deaths, decreased weight, skeletal changes, delayed skeletal development, birth defects, and enzyme changes in organs of unborn animals (ATSDR, 1990).

A chronic oral RfD of 2.00E+00 mg/kg-day is listed in IRIS for the xylenes. This value is based on a chronic rat gavage study in which males and females were given doses of 0, 250, or 500 mg/kg/day, 5 days/week for 103 weeks. In addition, similar studies were conducted in male and female mice at doses of 0, 500, or 1000 mg/kg/day. A dose-related increase in mortality was observed in male rats at the high-dose level (500 mg/kg-day converted to 357 mg/kg-day). Increases in mortality were also seen at the 250 mg/kg-day dose (converted to 179 mg/kg-day) but these increases were not statistically significant. Many of the early deaths were caused by gavage error. Mice given the high-dose (1000 mg/kg-day) exhibited CNS toxicity (hyperactivity). No treatment-related histopathologic lesions were observed and the high-dose (500 mg/kg-day) is a FEL (Frank Effect Level) and the low dose (250 mg/kg-day) a NOAEL. An uncertainty factor of 100 was chosen for species extrapolation and to protect sensitive individuals (10x each). A confidence rating of medium was given for the RfD even though the study was well designed and contained adequately sized groups of two species which were tested over a substantial portion of their lifespan. This rating reflects the fact that clinical chemistries, blood enzymes, and urinalyses were not performed.

EPA classifies xylene as Group D - Not Classifiable as to Human Carcinogenicity due to an inability of orally administered technical grade xylene to induce increased tumor response in rats and mice and lack of human data.

References

ATSDR, *Toxicological Profile for Total Xylenes*, 1990

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APPENDIX H

HUMAN HEALTH RISK MODEL OUTPUT

Note: **Risk estimates that are reported as a zero (0) do not necessarily represent a 0 risk. The number is reported as 0 if there is no toxicity value with which to calculate a risk estimate.**

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Table H-1
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Short-Term On-Base Resident (subchronic) Attributable to Fire Protection Training Area: Average Exposure Scenario

Analyte	Effective Air Concentrations ug/m3						Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Carcinogens				Non-Carcinogens									
	on off	Vapors	on off	Dust	Vapors	Dust	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins														
HpCDD Totals	0	0	1	2.1E-13	0	7.3E-12	0	6.9E-20	6.9E-20	*0.00*	0	0	0	*#DIV/0!*
OCDD	0	0	1	1.4E-12	0	4.8E-11	0	4.5E-20	4.5E-20	*0.00*	0	0	0	*#DIV/0!*
Metals	0	0	0	0	0	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Lead	0	0	1	1.2E-07	0	4.4E-06	0	0	0	*0.00*	0	0	0	*#DIV/0!*
PNAs	0	0	0	0	0	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Acenaphthylene	0	0	1	3.0E-10	0	1.1E-08	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Benzo(a)pyrene	0	0	1	3.6E-11	0	1.3E-09	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Benzo(g,h,i)perylene	0	0	1	9.8E-11	0	3.4E-09	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Phenanthrene	0	0	1	1.7E-08	0	5.9E-07	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Pesticides	0	0	0	0	0	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
4,4'-DDT	0	0	1	8.3E-10	0	2.9E-08	0	8.1E-14	8.1E-14	*1.25*	0	0	0	*#DIV/0!*
Aldrin	0	0	1	2.0E-11	0	6.9E-10	0	9.6E-14	9.6E-14	*1.49*	0	0	0	*#DIV/0!*
Heptachlor epoxide	0	0	1	6.4E-12	0	2.2E-10	0	1.7E-14	1.7E-14	*0.26*	0	0	0	*#DIV/0!*
Semi-Volatiles	0	0	0	0	0	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
2-Hexanone	1	3.8E-05	0	0	1.3E-03	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Volatiles	0	0	0	0	0	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Benzene	1	7.6E-07	0	0	2.6E-05	0	6.3E-12	0	6.3E-12	*97.01*	0	0	0	*#DIV/0!*
TOTALS		3.9E-05		1.4E-07	1.4E-03	5.0E-06	6.3E-12	1.9E-13	**6.5E-12**	***100***	0.0E+00	0.0E+00	**0.00**	***#DIV/0!***
% of Total Risk or HI							97.0	3.0		100.0	#DIV/0!	#DIV/0!		#DIV/0!

Table H-2

Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Short-Term On-Base Resident (subchronic) Attributable to Fire Protection Training Area: Reasonable Maximum Exposure Scenario

Analyte	Effective Air Concentrations ug/m3						Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Carcinogens				Non-Carcinogens									
	on off	Vapors	on off	Dust	Vapors	Dust	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins														
HpCDD Totals	0	0	1	6.6E-13	0	9.3E-12	0	2.2E-19	2.2E-19	*0.00*	0	0	0	*#DIV/0!*
OCDD	0	0	1	4.3E-12	0	6.1E-11	0	1.4E-19	1.4E-19	*0.00*	0	0	0	*#DIV/0!*
Metals	0	0	0	0	0	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Lead	0	0	1	4.0E-07	0	5.6E-06	0	0	0	*0.00*	0	0	0	*#DIV/0!*
PNAs	0	0	0	0	0	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Acenaphthylene	0	0	1	9.6E-10	0	1.3E-08	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Benzo(a)pyrene	0	0	1	1.1E-10	0	1.6E-09	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Benzo(g,h,i)perylene	0	0	1	3.1E-10	0	4.4E-09	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Phenanthrene	0	0	1	5.4E-08	0	7.5E-07	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Pesticides	0	0	0	0	0	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
4,4'-DDT	0	0	1	2.7E-09	0	3.7E-08	0	2.6E-13	2.6E-13	*1.25*	0	0	0	*#DIV/0!*
Aldrin	0	0	1	6.3E-11	0	8.8E-10	0	3.1E-13	3.1E-13	*1.49*	0	0	0	*#DIV/0!*
Heptachlor epoxide	0	0	1	2.0E-11	0	2.8E-10	0	5.3E-14	5.3E-14	*0.26*	0	0	0	*#DIV/0!*
Semi-Volatiles	0	0	1	0	0	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
2-Hexanone	1	1.2E-04	0	0	1.7E-03	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Volatiles	0	0	1	0	0	0	0	0	0	*0.00*	0	0	0	*#DIV/0!*
Benzene	1	2.4E-06	0	0	3.4E-05	0	2.0E-11	0	2.0E-11	*97.01*	0	0	0	*#DIV/0!*
TOTALS		1.2E-04		4.6E-07	1.7E-03	6.4E-06	2.0E-11	6.2E-13	**2.1E-11**	***100***	0.0E+00	0.0E+00	**0.0E+00**	***#DIV/0!***
% of Total Risk or HI							97.0	3.0		100.0	#DIV/0!	#DIV/0!		#DIV/0!

Table H-3
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Short-Term On-Base Resident (subchronic) Attributable to POL Tank Farm: Average Exposure Scenario

Analyte	Effective Air Concentrations ug/m3						Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Carcinogens				Non-Carcinogens									
	on off	Vapors	on off	Dust	Vapors	Dust	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals														
Lead	0	0	1	1.9E-06	0	6.6E-05	0	0	0	*0.000*	0	0	0	*#DIV/0!*
PNAs	0	0	0	0	0	0	0	0	0	*0.000*	0	0	0	*#DIV/0!*
2-Methylnapthalene	0	0	1	2.6E-07	0	9.2E-06	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Benz(a)anthracene	0	0	1	1.0E-09	0	3.7E-08	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Benzo(a)pyrene	0	0	1	7.1E-10	0	2.5E-08	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Benzo(b)fluoranthene	0	0	1	8.8E-10	0	3.1E-08	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Benzo(g,h,i)perylene	0	0	1	7.5E-10	0	2.6E-08	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Dibenz(a,h)anthracene	0	0	1	3.6E-10	0	1.3E-08	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Phenanthrene	0	0	1	7.1E-09	0	2.5E-07	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Pesticides	0	0	0	0	0	0	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Dieldrin	0	0	1	2.6E-10	0	9.1E-09	0	1.2E-12	1.2E-12	*0.003*	0	0	0	*#DIV/0!*
Volatiles	0	0	0	0	0	0	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Benzene	1	4.7E-03	0	0	1.6E-01	0	3.9E-08	0	3.9E-08	*99.997*	0	0	0	*#DIV/0!*
TOTALS		4.7E-03		2.2E-06	1.6E-01	7.6E-05	3.9E-08	1.2E-12	**3.9E-08**	***100***	0.0E+00	0.0E+00	**0.00**	***#DIV/0!***
% of Total Risk or HI							100.0	0.0		100.0	#DIV/0!	#DIV/0!		#DIV/0!

Table H-4
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Short-Term On-Base Resident (subchronic) Attributable to POL Tank Farm: Reasonable Maximum Exposure Scenario

Analyte	Effective Air Concentrations ug/m3						Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Carcinogens				Non-Carcinogens									
	on off	Vapors	on off	Dust	Vapors	Dust	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals														
Lead	0	0	1	6.0E-06	0	8.4E-05	0	0	0	*0.000*	0	0	0	*#DIV/0!*
PNAs	0	0	0	0	0	0	0	0	0	*0.000*	0	0	0	*#DIV/0!*
2-Methylnapthalene	0	0	1	8.4E-07	0	1.2E-05	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Benz(a)anthracene	0	0	1	3.3E-09	0	4.7E-08	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Benzo(a)pyrene	0	0	1	2.2E-09	0	3.1E-08	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Benzo(b)fluoranthene	0	0	1	2.8E-09	0	3.9E-08	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Benzo(g,h,i)perylene	0	0	1	2.4E-09	0	3.4E-08	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Dibenz(a,h)anthracene	0	0	1	1.2E-09	0	1.6E-08	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Phenanthrene	0	0	1	2.3E-08	0	3.2E-07	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Pesticides	0	0	0	0	0	0	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Dieldrin	0	0	1	8.2E-10	0	1.2E-08	0	3.8E-12	3.8E-12	*0.003*	0	0	0	*#DIV/0!*
Volatiles	0	0	0	0	0	0	0	0	0	*0.000*	0	0	0	*#DIV/0!*
Benzene	1	1.5E-02	0	0	2.1E-01	0	1.2E-07	0	1.2E-07	*99.997*	0	0	0	*#DIV/0!*
							0	0	0	*0.000*	0	0	0	*#DIV/0!*
TOTALS		1.5E-02		6.9E-06	2.1E-01	9.7E-05	1.2E-07	3.8E-12	**1.2E-07**	***100***	0.0E+00	0.0E+00	**0.00**	***#DIV/0!***
% of Total Risk or HI							100.0	0.0		100.0	#DIV/0!	#DIV/0!		#DIV/0!

Table H-5

Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Short-Term On-Base Resident (subchronic) Attributable to West Unit: Average Exposure Scenario

Analyte	Effective Air Concentrations ug/m3						Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Carcinogens				Non-Carcinogens									
	on off	Vapors	on off	Dust	Vapors	Dust	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals														
Aluminum	0	0	1	5.0E-07	0	1.8E-05	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Arsenic	0	0	1	1.3E-09	0	4.6E-08	0	5.7E-12	5.7E-12	*0.0757*	0	0	0	*#DIV/0!*
Beryllium	0	0	1	1.3E-11	0	4.5E-10	0	3.1E-14	3.1E-14	*0.0004*	0	0	0	*#DIV/0!*
Lead	0	0	1	5.3E-06	0	1.9E-04	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Manganese (dust)	0	0	1	2.0E-08	0	7.0E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
PNAs	0	0	0	0	0	0	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
2-Methylnaphthalene	0	0	1	1.1E-09	0	3.8E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Acenaphthylene	0	0	1	1.7E-10	0	5.8E-09	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Benz(a)anthracene	0	0	1	4.4E-09	0	1.5E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Benzo(a)pyrene	0	0	1	3.5E-09	0	1.2E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Benzo(b)fluoranthene	0	0	1	5.0E-09	0	1.7E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Benzo(g,h,i)perylene	0	0	1	2.1E-09	0	7.4E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Benzo(k)fluoranthene	0	0	1	4.1E-09	0	1.4E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Chrysene	0	0	1	4.4E-09	0	1.5E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Dibenz(a,h)anthracene	0	0	1	9.9E-10	0	3.5E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Indeno(1,2,3-cd)pyrene	0	0	1	1.7E-09	0	6.1E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Phenanthrene	0	0	1	4.9E-09	0	1.7E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Pesticides	0	0	0	0	0	0	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
4,4-DDD	0	0	1	4.0E-09	0	1.4E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
4,4-DDE	0	0	1	3.7E-10	0	1.3E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
4,4-DDT	0	0	1	5.4E-09	0	1.9E-07	0	5.2E-13	5.2E-13	*0.0070*	0	0	0	*#DIV/0!*
Aldrin	0	0	1	7.8E-12	0	2.7E-10	0	3.8E-14	3.8E-14	*0.0005*	0	0	0	*#DIV/0!*
alpha-BHC	0	0	1	7.3E-13	0	2.6E-11	0	1.3E-15	1.3E-15	*0.0000*	0	0	0	*#DIV/0!*
Dieldrin	0	0	1	1.9E-10	0	6.6E-09	0	8.7E-13	8.7E-13	*0.0116*	0	0	0	*#DIV/0!*
gamma-BHC	0	0	1	7.3E-12	0	2.6E-10	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Heptachlor epoxide	0	0	1	1.2E-12	0	4.3E-11	0	3.2E-15	3.2E-15	*0.0000*	0	0	0	*#DIV/0!*
Semi-Volatiles	0	0	0	0	0	0	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
2-Hexanone	1	2.5E-05	0	0	8.8E-04	0	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Pentachlorophenol	1	0	1	9.6E-10	0	3.4E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Volatiles	0	0	0	0	0	0	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
1,1,2,2-Tetrachloroethane	1	2.4E-07	0	0	8.4E-06	0	1.4E-11	0	1.4E-11	*0.1857*	0	0	0	*#DIV/0!*
Benzene	1	9.0E-04	0	0	3.1E-02	0	7.4E-09	0	7.4E-09	*99.7190*	0	0	0	*#DIV/0!*
TOTALS		9.2E-04		5.9E-06	3.2E-02	2.1E-04	7.5E-09	7.1E-12	7.5E-09	***100***	0.0E+00	0.0E+00	**0.00**	***#DIV/0!***
% of Total Risk or HI							99.9	0.1		100.0	#DIV/0!	#DIV/0!		#DIV/0!

Table H-6
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Short-Term On-Base Resident (subchronic) Attributable to West Unit: Reasonable Maximum Exposure Scenario

Analyte	Effective Air Concentrations ug/m3						Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Carcinogens				Non-Carcinogens									
	on off	Vapors	on off	Dust	Vapors	Dust	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals														
Aluminum	0	0	1	1.6E-06	0	2.2E-05	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Arsenic	0	0	1	4.2E-09	0	5.9E-08	0	1.8E-11	1.8E-11	*0.0757*	0	0	0	*#DIV/0!*
Beryllium	0	0	1	4.1E-11	0	5.7E-10	0	9.8E-14	9.8E-14	*0.0004*	0	0	0	*#DIV/0!*
Lead	0	0	1	1.7E-05	0	2.4E-04	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Manganese (dust)	0	0	1	6.4E-08	0	9.0E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
PNAs	0	0	0	0	0	0	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
2-Methylnaphthalene	0	0	1	3.5E-09	0	4.9E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Acenaphthylene	0	0	1	5.3E-10	0	7.4E-09	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Benz(a)anthracene	0	0	1	1.4E-08	0	1.9E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Benzo(a)pyrene	0	0	1	1.1E-08	0	1.6E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Benzo(b)fluoranthene	0	0	1	1.6E-08	0	2.2E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Benzo(g,h,i)perylene	0	0	1	6.8E-09	0	9.5E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Benzo(k)fluoranthene	0	0	1	1.3E-08	0	1.8E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Chrysene	0	0	1	1.4E-08	0	2.0E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Dibenz(a,h)anthracene	0	0	1	3.1E-09	0	4.4E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Indeno(1,2,3-cd)pyrene	0	0	1	5.5E-09	0	7.7E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Phenanthrene	0	0	1	1.5E-08	0	2.2E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Pesticides	0	0	0	0	0	0	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
4,4-DDD	0	0	1	1.3E-08	0	1.8E-07	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
4,4-DDE	0	0	1	1.2E-09	0	1.6E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
4,4-DDT	0	0	1	1.7E-08	0	2.4E-07	0	1.7E-12	1.7E-12	*0.0070*	0	0	0	*#DIV/0!*
Aldrin	0	0	1	2.5E-11	0	3.5E-10	0	1.2E-13	1.2E-13	*0.0005*	0	0	0	*#DIV/0!*
alpha-BHC	0	0	1	2.3E-12	0	3.3E-11	0	4.2E-15	4.2E-15	*0.0000*	0	0	0	*#DIV/0!*
Dieldrin	0	0	1	6.0E-10	0	8.4E-09	0	2.8E-12	2.8E-12	*0.0116*	0	0	0	*#DIV/0!*
gamma-BHC	0	0	1	2.3E-11	0	3.2E-10	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Heptachlor epoxide	0	0	1	3.9E-12	0	5.5E-11	0	1.0E-14	1.0E-14	*0.0000*	0	0	0	*#DIV/0!*
Semi-Volatiles	0	0	0	0	0	0	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
2-Hexanone	1	8.0E-05	0	0	1.1E-03	0	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Pentachlorophenol	0	0	1	3.1E-09	0	4.3E-08	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
Volatiles	0	0	0	0	0	0	0	0	0	*0.0000*	0	0	0	*#DIV/0!*
1,1,2,2-Tetrachloroethane	1	7.6E-07	0	0	1.1E-05	0	4.4E-11	0	4.4E-11	*0.1857*	0	0	0	*#DIV/0!*
Benzene	1	2.9E-03	0	0	4.0E-02	0	2.4E-08	0	2.4E-08	*99.7190*	0	0	0	*#DIV/0!*
TOTALS		2.9E-03		1.9E-05	4.1E-02	2.6E-04	2.4E-08	2.3E-11	**2.4E-08**	***100***	0.0E+00	0.0E+00	**0.00**	***#DIV/0!***
% of Total Risk or HI							99.9	0.1		100.0	#DIV/0!	#DIV/0!		#DIV/0!

Table H-7
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Long-Term On-Base Resident (chronic) Attributable to Fire Protection Training Area: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	3.1E-19	3.1E-19	*0.000*	0	0	0	*0.000*
OCDD	0	2.0E-19	2.0E-19	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	3.6E-13	3.6E-13	*1.250*	0	0	0	*0.000*
Aldrin	0	4.3E-13	4.3E-13	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	7.5E-14	7.5E-14	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	2.8E-11	0	2.8E-11	*97.006*	4.4E-06	0	4.4E-06	*100.000*
TOTALS	2.8E-11	8.7E-13	**2.9E-11**	***100***	4.4E-06	0.0E+00	**4.4E-06**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-8

Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Long-Term On-Base Resident (chronic) Attributable to Fire Protection Training Area: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	2.1E-19	2.1E-19	*0.000*	0	0	0	*0.000*
OCDD	0	1.3E-19	1.3E-19	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	2.4E-13	2.4E-13	*1.250*	0	0	0	*0.000*
Aldrin	0	2.9E-13	2.9E-13	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	5.0E-14	5.0E-14	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	1.9E-11	0	1.9E-11	*97.006*	4.4E-06	0	4.4E-06	*100.000*
TOTALS	1.9E-11	5.8E-13	**1.9E-11**	***100***	4.4E-06	0.0E+00	**4.4E-06**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-9
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Long-Term On-Base Resident (chronic) Attributable to Fire Protection Training Area: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	1.1E-18	1.1E-18	*0.000*	0	0	0	*0.000*
OCDD	0	7.2E-19	7.2E-19	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	1.3E-12	1.3E-12	*1.250*	0	0	0	*0.000*
Aldrin	0	1.5E-12	1.5E-12	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	2.6E-13	2.6E-13	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	1.0E-10	0	1.0E-10	*97.006*	5.6E-06	0	5.6E-06	*100.000*
TOTALS	1.0E-10	3.1E-12	**1.0E-10**	***100***	5.6E-06	0.0E+00	**5.6E-06**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-10

Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Long-Term On-Base Resident (chronic) Attributable to Fire Protection Training Area: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	2.6E-19	2.6E-19	*0.000*	0	0	0	*0.000*
OCDD	0	1.7E-19	1.7E-19	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	3.1E-13	3.1E-13	*1.250*	0	0	0	*0.000*
Aldrin	0	3.7E-13	3.7E-13	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	6.3E-14	6.3E-14	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	2.4E-11	0	2.4E-11	*97.006*	5.6E-06	0	5.6E-06	*100.000*
TOTALS	2.4E-11	7.4E-13	**2.5E-11**	***100***	5.6E-06	0.0E+00	**5.6E-06**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-11
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Long-Term On-Base Resident (chronic) Attributable to POL Tank Farm: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.00*
PNAs	0	0	0	*0.000*	0	0	0	*0.00*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.00*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.00*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.00*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.00*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.00*
Pesticides	0	0	0	*0.000*	0	0	0	*0.00*
Dieldrin	0	5.4E-12	5.4E-12	*0.003*	0	0	0	*0.00*
Volatiles	0	0	0	*0.000*	0	0	0	*0.00*
Benzene	1.7E-07	0	1.7E-07	*99.997*	2.7E-02	0	2.7E-02	*100.00*
TOTALS	1.7E-07	5.4E-12	**1.7E-07**	***100***	2.7E-02	0.0E+00	**2.7E-02**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

Table H-12
Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Long-Term On-Base Resident (chronic) Attributable to POL Tank Farm: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
Dieldrin	0	3.6E-12	3.6E-12	*0.003*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	1.2E-07	0	1.2E-07	*99.997*	2.7E-02	0	2.7E-02	*100.000*
TOTALS	1.2E-07	3.6E-12	**1.2E-07**	***100***	2.7E-02	0.0E+00	**2.7E-02**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

Table H-13
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Long-Term On-Base Resident (chronic) Attributable to POL Tank Farm: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
Dieldrin	0	1.9E-11	1.9E-11	*0.003*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	6.2E-07	0	6.2E-07	*99.997*	3.5E-02	0	3.5E-02	*100.000*
TOTALS	6.2E-07	1.9E-11	**6.2E-07**	***100***	3.5E-02	0.0E+00	**3.5E-02**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

Table H-14
Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Long-Term On-Base Resident (chronic) Attributable to POL Tank Farm: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
Dieldrin	0	4.6E-12	4.6E-12	*0.003*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	1.5E-07	0	1.5E-07	*99.997*	3.5E-02	0	3.5E-02	*100.000*
TOTALS	1.5E-07	4.6E-12	**1.5E-07**	***100***	3.5E-02	0.0E+00	**3.5E-02**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

Table H-15

Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Long-Term On-Base Resident (chronic) Attributable to West Unit: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.00*
Arsenic	0	2.5E-11	2.5E-11	*0.0757*	0	0	0	*0.00*
Beryllium	0	1.4E-13	1.4E-13	*0.0004*	0	0	0	*0.00*
Lead	0	0	0	*0.0000*	0	0	0	*0.00*
Manganese (dust)	0	0	0	*0.0000*	0	1.4E-05	1.41E-05	*0.27*
PNAs	0	0	0	*0.0000*	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.00*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.00*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDT	0	2.4E-12	2.4E-12	*0.0070*	0	0	0	*0.00*
Aldrin	0	1.7E-13	1.7E-13	*0.0005*	0	0	0	*0.00*
alpha-BHC	0	5.9E-15	5.9E-15	*0.0000*	0	0	0	*0.00*
Dieldrin	0	3.9E-12	3.9E-12	*0.0116*	0	0	0	*0.00*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Heptachlor epoxide	0	1.4E-14	1.4E-14	*0.0000*	0	0	0	*0.00*
Semi-Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.00*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.00*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	6.2E-11	0	6.2E-11	*0.1857*	0	0	0	*0.00*
Benzene	3.4E-08	0	3.4E-08	*99.7190*	5.2E-03	0	5.24E-03	*99.73*
TOTALS	3.4E-08	3.2E-11	3.4E-08	***100***	5.2E-03	1.4E-05	5.2E-03	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.7	0.3		100.0

Table H-16

Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Long-Term On-Base Resident (chronic) Attributable to West Unit: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.00*
Arsenic	0	1.7E-11	1.7E-11	*0.0757*	0	0	0	*0.00*
Beryllium	0	9.2E-14	9.2E-14	*0.0004*	0	0	0	*0.00*
Lead	0	0	0	*0.0000*	0	0	0	*0.00*
Manganese (dust)	0	0	0	*0.0000*	0	1.4E-05	1.41E-05	*0.27*
PNAs	0	0	0	*0.0000*	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.00*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.00*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDT	0	1.6E-12	1.6E-12	*0.0070*	0	0	0	*0.00*
Aldrin	0	1.1E-13	1.1E-13	*0.0005*	0	0	0	*0.00*
alpha-BHC	0	3.9E-15	3.9E-15	*0.0000*	0	0	0	*0.00*
Dieldrin	0	2.6E-12	2.6E-12	*0.0116*	0	0	0	*0.00*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Heptachlor epoxide	0	9.6E-15	9.6E-15	*0.0000*	0	0	0	*0.00*
Semi-Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.00*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.00*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	4.2E-11	0	4.2E-11	*0.1857*	0	0	0	*0.00*
Benzene	2.2E-08	0	2.2E-08	*99.7190*	5.2E-03	0	5.24E-03	*99.73*
TOTALS	2.2E-08	2.1E-11	**2.2E-08**	***100***	5.2E-03	1.4E-05	**5.3E-03**	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.8	0.3		100.0

Table H-17
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Long-Term On-Base Resident (chronic) Attributable to West Unit: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.00*
Arsenic	0	9.0E-11	9.0E-11	*0.0757*	0	0	0	*0.00*
Beryllium	0	4.9E-13	4.9E-13	*0.0004*	0	0	0	*0.00*
Lead	0	0	0	*0.0000*	0	0	0	*0.00*
Manganese (dust)	0	0	0	*0.0000*	0	1.8E-05	1.8E-05	*0.27*
PNAs	0	0	0	*0.0000*	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.00*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.00*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDT	0	8.3E-12	8.3E-12	*0.0070*	0	0	0	*0.00*
Aldrin	0	6.1E-13	6.1E-13	*0.0005*	0	0	0	*0.00*
alpha-BHC	0	2.1E-14	2.1E-14	*0.0000*	0	0	0	*0.00*
Dieldrin	0	1.4E-11	1.4E-11	*0.0116*	0	0	0	*0.00*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Heptachlor epoxide	0	5.1E-14	5.1E-14	*0.0000*	0	0	0	*0.00*
Semi-Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.00*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.00*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	2.2E-10	0	2.2E-10	*0.1857*	0	0	0	*0.00*
Benzene	1.2E-07	0	1.2E-07	*99.7190*	6.7E-03	0	6.7E-03	*99.73*
TOTALS	1.2E-07	1.1E-10	**1.2E-07**	***100***	6.7E-03	1.8E-05	**6.7E-03**	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.7	0.3		100.0

Table H-18
Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Long-Term On-Base Resident (chronic) Attributable to West Unit: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.00*
Arsenic	0	2.2E-11	2.2E-11	*0.0757*	0	0	0	*0.00*
Beryllium	0	1.2E-13	1.2E-13	*0.0004*	0	0	0	*0.00*
Lead	0	0	0	*0.0000*	0	0	0	*0.00*
Manganese (dust)	0	0	0	*0.0000*	0	1.8E-05	1.8E-05	*0.27*
PNAs	0	0	0	*0.0000*	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.00*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.00*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDT	0	2.0E-12	2.0E-12	*0.0070*	0	0	0	*0.00*
Aldrin	0	1.5E-13	1.5E-13	*0.0005*	0	0	0	*0.00*
alpha-BHC	0	5.0E-15	5.0E-15	*0.0000*	0	0	0	*0.00*
Dieldrin	0	3.3E-12	3.3E-12	*0.0116*	0	0	0	*0.00*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Heptachlor epoxide	0	1.2E-14	1.2E-14	*0.0000*	0	0	0	*0.00*
Semi-Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.00*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.00*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	5.3E-11	0	5.3E-11	*0.1857*	0	0	0	*0.00*
Benzene	2.8E-08	0	2.8E-08	*99.7190*	6.7E-03	0	6.7E-03	*99.73*
TOTALS	2.9E-08	2.7E-11	**2.9E-08**	***100***	6.7E-03	1.8E-05	**6.7E-03**	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.8	0.3		100.0

Table H-19
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Old Town Galena Resident (chronic) Attributable to Fire Protection Training Area: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	6.2E-18	6.2E-18	*0.000*	0	0	0	*0.000*
OCDD	0	4.1E-18	4.1E-18	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	7.3E-12	7.3E-12	*1.250*	0	0	0	*0.000*
Aldrin	0	8.7E-12	8.7E-12	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	1.5E-12	1.5E-12	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	5.7E-10	0	5.7E-10	*97.006*	3.2E-05	0	3.2E-05	*100.000*
TOTALS	5.7E-10	1.7E-11	**5.8E-10**	***100***	3.2E-05	0.0E+00	**3.2E-05**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-20

Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Old Town Galena Resident (chronic) Attributable to Fire Protection Training Area: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	1.5E-18	1.5E-18	*0.000*	0	0	0	*0.000*
OCDD	0	9.9E-19	9.9E-19	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	1.8E-12	1.8E-12	*1.250*	0	0	0	*0.000*
Aldrin	0	2.1E-12	2.1E-12	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	3.7E-13	3.7E-13	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	1.4E-10	0	1.4E-10	*97.006*	3.2E-05	0	3.2E-05	*100.000*
TOTALS	1.4E-10	4.3E-12	**1.4E-10**	***100***	3.2E-05	0.0E+00	**3.2E-05**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-21
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Old Town Galena Resident (chronic) Attributable to Fire Protection Training Area: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	2.3E-17	2.3E-17	*0.000*	0	0	0	*0.000*
OCDD	0	1.5E-17	1.5E-17	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	2.7E-11	2.7E-11	*1.250*	0	0	0	*0.000*
Aldrin	0	3.2E-11	3.2E-11	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	5.4E-12	5.4E-12	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	2.1E-09	0	2.1E-09	*97.006*	4.1E-05	0	4.1E-05	*100.000*
TOTALS	2.1E-09	6.4E-11	**2.1E-09**	***100***	4.1E-05	0.0E+00	**4.1E-05**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-22
Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Old Town Galena Resident (chronic) Attributable to Fire Protection Training Area: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	1.9E-18	1.9E-18	*0.000*	0	0	0	*0.000*
OCDD	0	1.3E-18	1.3E-18	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	2.3E-12	2.3E-12	*1.250*	0	0	0	*0.000*
Aldrin	0	2.7E-12	2.7E-12	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	4.7E-13	4.7E-13	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	1.8E-10	0	1.8E-10	*97.006*	4.1E-05	0	4.1E-05	*100.000*
TOTALS	1.8E-10	5.4E-12	**1.8E-10**	***100***	4.1E-05	0.0E+00	**4.1E-05**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-23
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Old Town Galena Resident (chronic) Attributable to POL Tank Farm: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
Dieldrin	0	1.5E-12	1.5E-12	*0.003*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	4.8E-08	0	4.8E-08	*99.997*	2.8E-03	0	2.8E-03	*100.000*
TOTALS	4.8E-08	1.5E-12	**4.8E-08**	***100***	2.8E-03	0.0E+00	**2.8E-03**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

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Table H-24
Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Old Town Galena Resident (chronic) Attributable to POL Tank Farm: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
Dieldrin	0	3.6E-13	3.6E-13	*0.003*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	1.2E-08	0	1.2E-08	*99.997*	2.8E-03	0	2.8E-03	*100.000*
TOTALS	1.2E-08	3.6E-13	**1.2E-08**	***100***	2.8E-03	0.0E+00	**2.8E-03**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

Table H-25
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Old Town Galena Resident (chronic) Attributable to POL Tank Farm: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
Dieldrin	0	5.4E-12	5.4E-12	*0.003*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	1.8E-07	0	1.8E-07	*99.997*	3.5E-03	0	3.5E-03	*100.000*
TOTALS	1.8E-07	5.4E-12	**1.8E-07**	***100***	3.5E-03	0.0E+00	**3.5E-03**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

Table H-26
Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Old Town Galena Resident (chronic) Attributable to POL Tank Farm: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
Dieldrin	0	4.6E-13	4.6E-13	*0.003*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	1.5E-08	0	1.5E-08	*99.997*	3.5E-03	0	3.5E-03	*100.000*
TOTALS	1.5E-08	4.6E-13	**1.5E-08**	***100***	3.5E-03	0.0E+00	**3.5E-03**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

Table H-27
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Old Town Galena Resident (chronic) Attributable to West Unit: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.000*
Arsenic	0	6.3E-12	6.3E-12	*0.0751*	0	0	0	*0.000*
Beryllium	0	7.0E-14	7.0E-14	*0.0008*	0	0	0	*0.000*
Lead	0	0	0	*0.0000*	0	0	0	*0.000*
Manganese (dust)	0	0	0	*0.0000*	0	2.6E-06	2.6E-06	*0.546*
PNAs	0	0	0	*0.0000*	0	0	0	*0.000*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.000*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.000*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDT	0	1.6E-12	1.6E-12	*0.0189*	0	0	0	*0.000*
Aldrin	0	1.2E-13	1.2E-13	*0.0014*	0	0	0	*0.000*
alpha-BHC	0	3.0E-15	3.0E-15	*0.0000*	0	0	0	*0.000*
Dieldrin	0	2.6E-12	2.6E-12	*0.0313*	0	0	0	*0.000*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.000*
Heptachlor epoxide	0	9.7E-15	9.7E-15	*0.0001*	0	0	0	*0.000*
Semi-volatiles	0	0	0	*0.0000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.000*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.000*
1,1,2,2-Tetrachloroethane	8.2E-11	0	8.2E-11	*0.9669*	0	0	0	*0.000*
Benzene	8.4E-09	0	8.4E-09	*98.9054*	4.8E-04	0	4.8E-04	*99.454*
TOTALS	8.4E-09	1.1E-11	**8.5E-09**	***100***	4.8E-04	2.6E-06	**4.83E-04**	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.5	0.5		100.0

Table H-28

Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Old Town Galena Resident (chronic) Attributable to West Unit: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.000*
Arsenic	0	1.6E-12	1.6E-12	*0.0751*	0	0	0	*0.000*
Beryllium	0	1.7E-14	1.7E-14	*0.0008*	0	0	0	*0.000*
Lead	0	0	0	*0.0000*	0	0	0	*0.000*
Manganese (dust)	0	0	0	*0.0000*	0	2.6E-06	2.6E-06	*0.546*
PNAs	0	0	0	*0.0000*	0	0	0	*0.000*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.000*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.000*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDT	0	3.9E-13	3.9E-13	*0.0189*	0	0	0	*0.000*
Aldrin	0	2.9E-14	2.9E-14	*0.0014*	0	0	0	*0.000*
alpha-BHC	0	7.4E-16	7.4E-16	*0.0000*	0	0	0	*0.000*
Dieldrin	0	6.5E-13	6.5E-13	*0.0313*	0	0	0	*0.000*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.000*
Heptachlor epoxide	0	2.4E-15	2.4E-15	*0.0001*	0	0	0	*0.000*
Semi-volatiles	0	0	0	*0.0000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.000*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.000*
1,1,2,2-Tetrachloroethane	2.0E-11	0	2.0E-11	*0.9669*	0	0	0	*0.000*
Benzene	2.0E-09	0	2.0E-09	*98.9054*	4.8E-04	0	4.8E-04	*99.454*
TOTALS	2.1E-09	2.6E-12	**2.1E-09**	***100***	4.8E-04	2.6E-06	**4.83E-04**	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.5	0.5		100.0

Table H-29
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current Old Town Galena Resident (chronic) Attributable to West Unit: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.000*
Arsenic	0	2.3E-11	2.3E-11	*0.0751*	0	0	0	*0.000*
Beryllium	0	2.6E-13	2.6E-13	*0.0008*	0	0	0	*0.000*
Lead	0	0	0	*0.0000*	0	0	0	*0.000*
Manganese (dust)	0	0	0	*0.0000*	0	3.4E-06	3.4E-06	*0.546*
PNAs	0	0	0	*0.0000*	0	0	0	*0.000*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.000*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.000*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDT	0	5.8E-12	5.8E-12	*0.0189*	0	0	0	*0.000*
Aldrin	0	4.2E-13	4.2E-13	*0.0014*	0	0	0	*0.000*
alpha-BHC	0	1.1E-14	1.1E-14	*0.0000*	0	0	0	*0.000*
Dieldrin	0	9.6E-12	9.6E-12	*0.0313*	0	0	0	*0.000*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.000*
Heptachlor epoxide	0	3.5E-14	3.5E-14	*0.0001*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.0000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.000*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.000*
1,1,2,2-Tetrachloroethane	3.0E-10	0	3.0E-10	*0.9669*	0	0	0	*0.000*
Benzene	3.0E-08	0	3.0E-08	*98.9054*	6.1E-04	0	6.1E-04	*99.454*
TOTALS	3.1E-08	3.9E-11	3.1E-08	***100***	6.1E-04	3.4E-06	6.14E-04	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.5	0.5		100.0

Table H-30

Carcinogenic and Noncarcinogenic Risk Estimates for Child Current Old Town Galena Resident (chronic) Attributable to West Unit: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.000*
Arsenic	0	2.0E-12	2.0E-12	*0.0751*	0	0	0	*0.000*
Beryllium	0	2.2E-14	2.2E-14	*0.0008*	0	0	0	*0.000*
Lead	0	0	0	*0.0000*	0	0	0	*0.000*
Manganese (dust)	0	0	0	*0.0000*	0	3.4E-06	3.4E-06	*0.546*
PNAs	0	0	0	*0.0000*	0	0	0	*0.000*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.000*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.000*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.000*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.000*
4,4-DDT	0	5.0E-13	5.0E-13	*0.0189*	0	0	0	*0.000*
Aldrin	0	3.6E-14	3.6E-14	*0.0014*	0	0	0	*0.000*
alpha-BHC	0	9.4E-16	9.4E-16	*0.0000*	0	0	0	*0.000*
Dieldrin	0	8.2E-13	8.2E-13	*0.0313*	0	0	0	*0.000*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.000*
Heptachlor epoxide	0	3.0E-15	3.0E-15	*0.0001*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.0000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.000*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.000*
1,1,2,2-Tetrachloroethane	2.5E-11	0	2.5E-11	*0.9669*	0	0	0	*0.000*
Benzene	2.6E-09	0	2.6E-09	*98.9054*	6.1E-04	0	6.1E-04	*99.454*
TOTALS	2.6E-09	3.4E-12	2.6E-09	***100***	6.1E-04	3.4E-06	6.14E-04	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.5	0.5		100.0

Table H-31

Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current New Town Galena Resident (chronic) Attributable to Fire Protection Training Area: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	2.9E-18	2.9E-18	*0.000*	0	0	0	*0.000*
OCDD	0	1.9E-18	1.9E-18	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	3.4E-12	3.4E-12	*1.250*	0	0	0	*0.000*
Aldrin	0	4.1E-12	4.1E-12	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	7.0E-13	7.0E-13	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	2.7E-10	0	2.7E-10	*97.006*	1.5E-05	0	1.5E-05	*100.000*
TOTALS	2.7E-10	8.2E-12	**2.7E-10**	***100***	1.5E-05	0.0E+00	**1.5E-05**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-32
Carcinogenic and Noncarcinogenic Risk Estimates for Child Current New Town Galena Resident (chronic) Attributable to Fire Protection Training Area: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	7.2E-19	7.2E-19	*0.000*	0	0	0	*0.000*
OCDD	0	4.7E-19	4.7E-19	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	8.4E-13	8.4E-13	*1.250*	0	0	0	*0.000*
Aldrin	0	1.0E-12	1.0E-12	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	1.7E-13	1.7E-13	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	6.5E-11	0	6.5E-11	*97.006*	1.5E-05	0	1.5E-05	*100.000*
TOTALS	6.5E-11	2.0E-12	**6.7E-11**	***100***	1.5E-05	0.0E+00	**1.5E-05**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-33
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current New Town Galena Resident (chronic) Attributable to Fire Protection Training Area: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	1.1E-17	1.1E-17	*0.000*	0	0	0	*0.000*
OCDD	0	6.9E-18	6.9E-18	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	1.2E-11	1.2E-11	*1.250*	0	0	0	*0.000*
Aldrin	0	1.5E-11	1.5E-11	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	2.6E-12	2.6E-12	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	9.7E-10	0	9.7E-10	*97.006*	1.9E-05	0	1.9E-05	*100.000*
TOTALS	9.7E-10	3.0E-11	**1.0E-09**	***100***	1.9E-05	0.0E+00	**1.9E-05**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-34

Carcinogenic and Noncarcinogenic Risk Estimates for Child Current New Town Galena Resident (chronic) Attributable to Fire Protection Training Area: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Dioxins								
HpCDD Totals	0	9.1E-19	9.1E-19	*0.000*	0	0	0	*0.000*
OCDD	0	6.0E-19	6.0E-19	*0.000*	0	0	0	*0.000*
Metals	0	0	0	*0.000*	0	0	0	*0.000*
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
Acenaphthylene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
4,4'-DDT	0	1.1E-12	1.1E-12	*1.250*	0	0	0	*0.000*
Aldrin	0	1.3E-12	1.3E-12	*1.488*	0	0	0	*0.000*
Heptachlor epoxide	0	2.2E-13	2.2E-13	*0.256*	0	0	0	*0.000*
Semi-Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
2-Hexanone	0	0	0	*0.000*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	8.3E-11	0	8.3E-11	*97.006*	1.9E-05	0	1.9E-05	*100.000*
TOTALS	8.3E-11	2.6E-12	**8.6E-11**	***100***	1.9E-05	0.0E+00	**1.9E-05**	***100***
% of Total Risk or HI	97.0	3.0		100.0	100.0	0.0		100.0

Table H-35
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current New Town Galena Resident (chronic) Attributable to POL Tank Farm: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
Dieldrin	0	9.9E-14	9.9E-14	*0.003*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	3.2E-09	0	3.2E-09	*99.997*	1.8E-04	0	1.8E-04	*100.000*
TOTALS	3.2E-09	9.9E-14	**3.2E-09**	***100***	1.8E-04	0.0E+00	**1.8E-04**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

Table H-36
Carcinogenic and Noncarcinogenic Risk Estimates for Child Current New Town Galena Resident (chronic) Attributable to POL Tank Farm: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
Dieldrin	0	2.4E-14	2.4E-14	*0.003*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	7.9E-10	0	7.9E-10	*99.997*	1.8E-04	0	1.8E-04	*100.000*
TOTALS	7.9E-10	2.4E-14	**7.9E-10**	***100***	1.8E-04	0.0E+00	**1.8E-04**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

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Table H-37
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current New Town Galena Resident (chronic) Attributable to POL Tank Farm: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
Dieldrin	0	3.6E-13	3.6E-13	*0.003*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	1.2E-08	0	1.2E-08	*99.997*	2.4E-04	0	2.4E-04	*100.000*
TOTALS	1.2E-08	3.6E-13	**1.2E-08**	***100***	2.4E-04	0.0E+00	**2.4E-04**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

Table H-38

Carcinogenic and Noncarcinogenic Risk Estimates for Child Current New Town Galena Resident (chronic) Attributable to POL Tank Farm: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Lead	0	0	0	*0.000*	0	0	0	*0.000*
PNAs	0	0	0	*0.000*	0	0	0	*0.000*
2-Methylnapthalene	0	0	0	*0.000*	0	0	0	*0.000*
Benz(a)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(b)fluoranthene	0	0	0	*0.000*	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	*0.000*	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	0	0	*0.000*	0	0	0	*0.000*
Phenanthrene	0	0	0	*0.000*	0	0	0	*0.000*
Pesticides	0	0	0	*0.000*	0	0	0	*0.000*
Dieldrin	0	3.1E-14	3.1E-14	*0.003*	0	0	0	*0.000*
Volatiles	0	0	0	*0.000*	0	0	0	*0.000*
Benzene	1.0E-09	0	1.0E-09	*99.997*	2.4E-04	0	2.4E-04	*100.000*
TOTALS	1.0E-09	3.1E-14	**1.0E-09**	***100***	2.4E-04	0.0E+00	**2.4E-04**	***100***
% of Total Risk or HI	100.0	0.0		100.0	100.0	0.0		100.0

Table H-39
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current New Town Galena Resident (chronic) Attributable to West Unit: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.00*
Arsenic	0	5.4E-13	5.4E-13	*0.0754*	0	0	0	*0.00*
Beryllium	0	5.2E-15	5.2E-15	*0.0007*	0	0	0	*0.00*
Lead	0	0	0	*0.0000*	0	0	0	*0.00*
Manganese (dust)	0	0	0	*0.0000*	0	2.0E-07	2.0E-07	*0.48*
PNAs	0	0	0	*0.0000*	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.00*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.00*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDT	0	1.1E-13	1.1E-13	*0.0154*	0	0	0	*0.00*
Aldrin	0	8.1E-15	8.1E-15	*0.0011*	0	0	0	*0.00*
alpha-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Dieldrin	0	1.8E-13	1.8E-13	*0.0254*	0	0	0	*0.00*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Heptachlor epoxide	0	6.8E-16	6.8E-16	*0.0001*	0	0	0	*0.00*
Semi-Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.00*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.00*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	4.4E-12	0	4.4E-12	*0.6131*	0	0	0	*0.00*
Benzene	7.2E-10	0	7.2E-10	*99.2688*	4.1E-05	0	4.1E-05	*99.52*
TOTALS	7.2E-10	8.5E-13	**7.2E-10**	***100***	4.1E-05	2.0E-07	**4.13E-05**	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.5	0.5		100.0

Table H-40
Carcinogenic and Noncarcinogenic Risk Estimates for Child Current New Town Galena Resident (chronic) Attributable to West Unit: Average Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.00*
Arsenic	0	1.3E-13	1.3E-13	*0.0754*	0	0	0	*0.00*
Beryllium	0	1.3E-15	1.3E-15	*0.0007*	0	0	0	*0.00*
Lead	0	0	0	*0.0000*	0	0	0	*0.00*
Manganese (dust)	0	0	0	*0.0000*	0	2.0E-07	2.0E-07	*0.48*
PNAs	0	0	0	*0.0000*	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.00*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.00*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDT	0	2.7E-14	2.7E-14	*0.0154*	0	0	0	*0.00*
Aldrin	0	2.0E-15	2.0E-15	*0.0011*	0	0	0	*0.00*
alpha-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Dieldrin	0	4.5E-14	4.5E-14	*0.0254*	0	0	0	*0.00*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Heptachlor epoxide	0	1.7E-16	1.7E-16	*0.0001*	0	0	0	*0.00*
Semi-Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.00*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.00*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	1.1E-12	0	1.1E-12	*0.6131*	0	0	0	*0.00*
Benzene	1.8E-10	0	1.8E-10	*99.2688*	4.1E-05	0	4.1E-05	*99.52*
TOTALS	1.8E-10	2.1E-13	1.8E-10	***100***	4.1E-05	2.0E-07	4.13E-05	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.6	0.5		100.0

Table H-41
Carcinogenic and Noncarcinogenic Risk Estimates for Adult Current New Town Galena Resident (chronic) Attributable to West Unit: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.00*
Arsenic	0	2.0E-12	2.0E-12	*0.0754*	0	0	0	*0.00*
Beryllium	0	1.9E-14	1.9E-14	*0.0007*	0	0	0	*0.00*
Lead	0	0	0	*0.0000*	0	0	0	*0.00*
Manganese (dust)	0	0	0	*0.0000*	0	2.5E-07	2.5E-07	*0.48*
PNAs	0	0	0	*0.0000*	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.00*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.00*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDT	0	4.0E-13	4.0E-13	*0.0154*	0	0	0	*0.00*
Aldrin	0	2.9E-14	2.9E-14	*0.0011*	0	0	0	*0.00*
alpha-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Dieldrin	0	6.7E-13	6.7E-13	*0.0254*	0	0	0	*0.00*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Heptachlor epoxide	0	2.5E-15	2.5E-15	*0.0001*	0	0	0	*0.00*
Semi-Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.00*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.00*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	1.6E-11	0	1.6E-11	*0.6131*	0	0	0	*0.00*
Benzene	2.6E-09	0	2.6E-09	*99.2688*	5.2E-05	0	5.2E-05	*99.52*
TOTALS	2.6E-09	3.1E-12	**2.6E-09**	***100***	5.2E-05	2.5E-07	**5.25E-05**	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.5	0.5		100.0

Table H-42

Carcinogenic and Noncarcinogenic Risk Estimates for Child Current New Town Galena Resident (chronic) Attributable to West Unit: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk Summary				Non-Cancer Hazard Index Summary			
	Vapor Inhalation	Dust Inhalation	Total Risk	% of Total Risk	Vapor Inhalation	Dust Inhalation	Total Hazard Index	% of Total HI
Metals								
Aluminum	0	0	0	*0.0000*	0	0	0	*0.00*
Arsenic	0	1.7E-13	1.7E-13	*0.0754*	0	0	0	*0.00*
Beryllium	0	1.6E-15	1.6E-15	*0.0007*	0	0	0	*0.00*
Lead	0	0	0	*0.0000*	0	0	0	*0.00*
Manganese (dust)	0	0	0	*0.0000*	0	2.5E-07	2.5E-07	*0.48*
PNAs	0	0	0	*0.0000*	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	*0.0000*	0	0	0	*0.00*
Acenaphthylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benz(a)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(a)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(b)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	*0.0000*	0	0	0	*0.00*
Benzo(k)fluoranthene	0	0	0	*0.0000*	0	0	0	*0.00*
Chrysene	0	0	0	*0.0000*	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	0	0	*0.0000*	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	0	0	*0.0000*	0	0	0	*0.00*
Phenanthrene	0	0	0	*0.0000*	0	0	0	*0.00*
Pesticides	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDD	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDE	0	0	0	*0.0000*	0	0	0	*0.00*
4,4-DDT	0	3.5E-14	3.5E-14	*0.0154*	0	0	0	*0.00*
Aldrin	0	2.5E-15	2.5E-15	*0.0011*	0	0	0	*0.00*
alpha-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Dieldrin	0	5.7E-14	5.7E-14	*0.0254*	0	0	0	*0.00*
gamma-BHC	0	0	0	*0.0000*	0	0	0	*0.00*
Heptachlor epoxide	0	2.1E-16	2.1E-16	*0.0001*	0	0	0	*0.00*
Semi-Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
2-Hexanone	0	0	0	*0.0000*	0	0	0	*0.00*
Pentachlorophenol	0	0	0	*0.0000*	0	0	0	*0.00*
Volatiles	0	0	0	*0.0000*	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	1.4E-12	0	1.4E-12	*0.6131*	0	0	0	*0.00*
Benzene	2.2E-10	0	2.2E-10	*99.2688*	5.2E-05	0	5.2E-05	*99.52*
TOTALS	2.2E-10	2.7E-13	**2.2E-10**	***100***	5.2E-05	2.5E-07	**5.26E-05**	***100***
% of Total Risk or HI	99.9	0.1		100.0	99.6	0.5		100.0

Table H-43
Carcinogenic and Noncarcinogenic Risk Estimates for Current Short-Term On-Base Worker (subchronic) Attributable to Fire Protection Training Area:Average Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways		Total Risk	% of Total Risk	Surface Soil Pathways		Inhalation Pathways		Hazard Index	% of Total Index
	Dermal Contact	Ingestion	Vapors	Dust			Dermal Contact	Ingestion	Vapors	Dust		
Dioxins												
HpCDD Totals	7.9E-09	1.3E-09	0	1.7E-16	9.2E-09	*17.76*	0	0	0	0	0	*0.00*
OCDD	5.1E-09	8.6E-10	0	1.1E-16	6.0E-09	*11.61*	0	0	0	0	0	*0.00*
Metals	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Lead	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
PNAs	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Acenaphthylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	1.1E-09	0	0	1.1E-09	*2.05*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
4,4'-DDT	6.8E-09	1.1E-09	0	2.0E-10	8.2E-09	*15.88*	1.4E-03	2.3E-04	0	0	1.6E-03	*59.29*
Aldrin	8.1E-09	1.3E-09	0	2.4E-10	9.7E-09	*18.72*	5.5E-04	9.2E-05	0	0	6.5E-04	*23.29*
Heptachlor epoxide	1.4E-09	2.3E-10	0	4.2E-11	1.7E-09	*3.25*	4.1E-04	6.9E-05	0	0	4.8E-04	*17.42*
Semi-Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Hexanone	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzene	0	0	1.6E-08	0	1.6E-08	*30.73*	0	0	0	0	0	*0.00*
TOTALS	2.9E-08	5.9E-09	1.6E-08	4.9E-10	**5.2E-08**	*100*	2.4E-03	4.0E-04	0.0E+00	0.0E+00	**2.8E-03**	*100*
% of Total Risk or HI	56.8	11.5	30.7	0.9		100.0	85.7	14.3	0.0	0.0		100.0

Table H-44

Carcinogenic and Noncarcinogenic Risk Estimates for Current Short-Term On-Base Worker (subchronic) Attributable to Fire Protection Training Area: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways		Total Risk	% of Total Risk	Surface Soil Pathways		Inhalation Pathways		Hazard Index	% of Total Index
	Dermal Absorption	Ingestion	Vapors	Dust			Dermal Absorption	Ingestion	Vapors	Dust		
Dioxins												
HpCDD Totals	3.3E-08	3.3E-09	0	1.3E-15	3.6E-08	*13.87*	0	0	0	0	0	*0.00*
OCDD	2.1E-08	2.1E-09	0	8.5E-16	2.4E-08	*9.06*	0	0	0	0	0	*0.00*
Metals	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Lead	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
PNAs	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Acenaphthylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	2.6E-09	0	0	2.6E-09	*1.02*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
4,4'-DDT	2.9E-08	2.9E-09	0	1.5E-09	3.3E-08	*12.68*	2.3E-03	2.3E-04	0	0	2.6E-03	*59.29*
Aldrin	3.4E-08	3.4E-09	0	1.8E-09	3.9E-08	*14.95*	9.2E-04	9.2E-05	0	0	1.0E-03	*23.29*
Heptachlor epoxide	5.8E-09	5.8E-10	0	3.1E-10	6.7E-09	*2.59*	6.9E-04	6.9E-05	0	0	7.6E-04	*17.42*
Semi-Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Hexanone	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzene	0	0	1.2E-07	0	1.2E-07	*45.82*	0	0	0	0	0	*0.00*
TOTALS	1.2E-07	1.5E-08	1.2E-07	3.7E-09	**2.6E-07**	*100*	4.0E-03	4.0E-04	0.0E+00	0.0E+00	**4.4E-03**	*100*
% of Total Risk or HI	47.0	5.7	45.8	1.4		100.0	90.9	9.1	0.0	0.0		100.0

Table H-45
Carcinogenic and Noncarcinogenic Risk Estimates for Current Short-Term On-Base Worker (subchronic) Attributable to POL Tank Farm: Average Exposure Scenario

Analyte	Cancer Risk By Pathway: Surface Soil Pathways: Dermal Contact	Cancer Risk: Surface Soil: Ingestion	Cancer Risk: Inhalation Pathways: Vapors	Cancer Risk: Inhalation: Dust	Total Risk	% of Total Risk	Hazard Index By Pathway: Surface Soil Pathways: Dermal Contact	HI: Surface Soil: Ingestion	HI: Inhalation Pathways: Vapors	HI: Inhalation: Dust	Hazard Index	% of Total Index
Metals												
Lead	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
PNAs	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
2-Methylnaphthalene	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
Benz(a)anthracene	0	2.9E-10	0	0	2.9E-10	*0.1*	0	0	0	0	0	*0.0*
Benzo(a)pyrene	0	2.0E-09	0	0	2.0E-09	*0.8*	0	0	0	0	0	*0.0*
Benzo(b)fluoranthene	0	2.4E-10	0	0	2.4E-10	*0.1*	0	0	0	0	0	*0.0*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
Dibenz(a,h)anthracene	0	1.0E-09	0	0	1.0E-09	*0.4*	0	0	0	0	0	*0.0*
Phenanthrene	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
Pesticides	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
Dieldrin	9.4E-09	1.6E-09	0	7.0E-12	1.1E-08	*4.5*	4.1E-04	6.9E-05	0	0	4.8E-04	*100.0*
Volatiles	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
Benzene	0	0	2.3E-07	0	2.3E-07	*94.0*	0	0	0	0	0	*0.0*
TOTALS	9.4E-09	5.1E-09	2.3E-07	7.0E-12	**2.4E-07**	*100*	4.1E-04	6.9E-05	0.0E+00	0.0E+00	**4.8E-04**	*100*
% of Total Risk or HI	3.9	2.1	94.0	0.0		100.0	85.7	14.3	0.0	0.0		100.0

Table H-46
Carcinogenic and Noncarcinogenic Risk Estimates for Current Short-Term On-Base Worker (subchronic) Attributable to POL Tank Farm: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways		Total Risk	% of Total Risk	Surface Soil Pathways		Inhalation Pathways		Hazard Index	% of Total Index
	Dermal Absorption	Ingestion	Vapors	Dust			Dermal Absorption	Ingestion	Vapors	Dust		
Metals												
Lead	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
PNAs	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benz(a)anthracene	0	7.2E-10	0	0	7.2E-10	*0.04*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	4.9E-09	0	0	4.9E-09	*0.28*	0	0	0	0	0	*0.00*
Benzo(b)fluoranthene	0	6.1E-10	0	0	6.1E-10	*0.03*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	2.5E-09	0	0	2.5E-09	*0.14*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Dieldrin	3.9E-08	3.9E-09	0	5.3E-11	4.3E-08	*2.45*	6.9E-04	6.9E-05	0	0	7.6E-04	*100.00*
Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzene	0	0	1.7E-06	0	1.7E-06	*97.05*	0	0	0	0	0	*0.00*
TOTALS	3.9E-08	1.3E-08	1.7E-06	5.3E-11	**1.8E-06**	*100*	6.9E-04	6.9E-05	0.0E+00	0.0E+00	**7.6E-04**	*100*
% of Total Risk or HI	2.2	0.7	97.1	0.0		100.0	90.9	9.1	0.0	0.0		100.0

Table H-47

Carcinogenic and Noncarcinogenic Risk Estimates for Current Short-Term On-Base Worker (subchronic) Attributable to West Unit: Average Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways				Surface Soil Pathways		Inhalation Pathways			
	Dermal Contact	Ingestion	Vapors	Dust	Total Risk	% of Total Risk	Dermal Contact	Ingestion	Vapors	Dust	Hazard Index	% of Total Index
Metals												
Aluminum	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Arsenic	1.6E-07	2.7E-07	0	1.8E-09	4.4E-07	*41.90*	1.3E-02	2.1E-02	0	0	3.4E-02	*73.84*
Beryllium	0	6.5E-09	0	1.4E-11	6.5E-09	*0.62*	0	1.1E-05	0	0	1.1E-05	*0.02*
Lead	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Manganese (food/dust)	0	0	0	0	0	*0.00*	0	4.9E-04	0	0	4.9E-04	*1.07*
PNAs	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Acenaphthylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benz(a)anthracene	0	6.2E-09	0	0	6.2E-09	*0.59*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	5.3E-08	0	0	5.3E-08	*5.01*	0	0	0	0	0	*0.00*
Benzo(b)fluoranthene	0	7.6E-09	0	0	7.6E-09	*0.72*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzo(k)fluoranthene	0	6.5E-10	0	0	6.5E-10	*0.06*	0	0	0	0	0	*0.00*
Chrysene	0	6.7E-11	0	0	6.7E-11	*0.01*	0	0	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	1.4E-08	0	0	1.4E-08	*1.32*	0	0	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	2.6E-09	0	0	2.6E-09	*0.25*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
4,4'-DDD	1.7E-08	2.8E-09	0	0	1.9E-08	*1.85*	0	0	0	0	0	*0.00*
4,4'-DDE	3.2E-09	5.4E-10	0	0	3.8E-09	*0.36*	0	0	0	0	0	*0.00*
4,4'-DDT	3.7E-08	6.2E-09	0	1.9E-11	4.4E-08	*4.14*	7.7E-03	1.3E-03	0	0	9.0E-03	*19.37*
Aldrin	2.1E-09	3.4E-10	0	9.5E-13	2.4E-09	*0.23*	1.4E-04	2.4E-05	0	0	1.6E-04	*0.36*
alpha-BHC	1.4E-09	2.4E-10	0	3.0E-13	1.7E-09	*0.16*	0	0	0	0	0	*0.00*
Dieldrin	4.5E-08	7.5E-09	0	2.2E-11	5.3E-08	*5.02*	2.0E-03	3.3E-04	0	0	2.3E-03	*4.99*
gamma-BHC	4.2E-10	6.9E-11	0	0	4.9E-10	*0.05*	3.7E-06	6.2E-07	0	0	4.4E-06	*0.01*
Heptachlor epoxide	4.2E-10	6.9E-11	0	7.9E-14	4.8E-10	*0.05*	1.2E-04	2.0E-05	0	0	1.4E-04	*0.31*
Semi-Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Hexanone	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Pentachlorophenol	1.2E-09	2.0E-10	0	0	1.4E-09	*0.13*	1.1E-05	1.9E-06	0	0	1.3E-05	*0.03*
Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
1,1,2,2,-Tetrachloroethane	0	0	2.3E-10	0	2.3E-10	*0.02*	0	0	0	0	0	*0.00*
Benzene	1.9E-09	3.2E-10	3.9E-07	0	4.0E-07	*37.54*	0	0	0	0	0	*0.00*
TOTALS	2.7E-07	3.8E-07	3.9E-07	1.8E-09	**1.1E-06**	*100*	2.3E-02	2.4E-02	0.0E+00	0.0E+00	**4.6E-02**	*100*
% of Total Risk or HI	26.1	36.4	37.3	0.2		100.0	4.9E+01	50.8	0	0		100.0

Table H-48
Carcinogenic and Noncarcinogenic Risk Estimates for Current Short-Term On-Base Worker (subchronic) Attributable to West Unit: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways				Surface Soil Pathways		Inhalation Pathways			
	Dermal Absorption	Ingestion	Vapors	Dust	Total Risk	% of Total Risk	Dermal Absorption	Ingestion	Vapors	Dust	Hazard Index	% of Total Index
Metals												
Aluminum	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Arsenic	6.9E-07	6.9E-07	0	1.3E-08	1.4E-06	*27.367*	2.1E-02	2.1E-02	0	0	4.3E-02	*69.51*
Beryllium	0	1.6E-08	0	1.1E-10	1.6E-08	*0.323*	0	1.1E-05	0	0	1.1E-05	*0.02*
Lead	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Manganese (food/dust)	0	0	0	0	0	*0.000*	0	4.9E-04	0	0	4.9E-04	*0.80*
PNAs	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Acenaphthylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Benz(a)anthracene	0	1.5E-08	0	0	1.5E-08	*0.306*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	1.3E-07	0	0	1.3E-07	*2.605*	0	0	0	0	0	*0.00*
Benzo(b)fluoranthene	0	1.9E-08	0	0	1.9E-08	*0.373*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Benzo(k)fluoranthene	0	1.6E-09	0	0	1.6E-09	*0.032*	0	0	0	0	0	*0.00*
Chrysene	0	1.7E-10	0	0	1.7E-10	*0.003*	0	0	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	3.5E-08	0	0	3.5E-08	*0.684*	0	0	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	6.5E-09	0	0	6.5E-09	*0.128*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
4,4'-DDD	6.9E-08	6.9E-09	0	0	7.6E-08	*1.507*	0	0	0	0	0	*0.00*
4,4'-DDE	1.3E-08	1.3E-09	0	0	1.5E-08	*0.292*	0	0	0	0	0	*0.00*
4,4'-DDT	1.6E-07	1.6E-08	0	1.4E-10	1.7E-07	*3.379*	1.3E-02	1.3E-03	0	0	1.4E-02	*22.92*
Aldrin	8.6E-09	8.6E-10	0	7.1E-12	9.4E-09	*0.186*	2.4E-04	2.4E-05	0	0	2.6E-04	*0.42*
alpha-BHC	6.0E-09	6.0E-10	0	2.3E-12	6.6E-09	*0.129*	0	0	0	0	0	*0.00*
Dieldrin	1.9E-07	1.9E-08	0	1.6E-10	2.1E-07	*4.097*	3.3E-03	3.3E-04	0	0	3.6E-03	*5.91*
gamma-BHC	1.7E-09	1.7E-10	0	0	1.9E-09	*0.038*	6.2E-06	6.2E-07	0	0	6.9E-06	*0.01*
Heptachlor epoxide	1.7E-09	1.7E-10	0	6.0E-13	1.9E-09	*0.038*	2.0E-04	2.0E-05	0	0	2.3E-04	*0.37*
Semi-Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
2-Hexanone	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Pentachlorophenol	4.9E-09	4.9E-10	0	0	5.4E-09	*0.107*	1.9E-05	1.9E-06	0	0	2.1E-05	*0.03*
Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	0	0	1.7E-09	0	1.7E-09	*0.034*	0	0	0	0	0	*0.00*
Benzene	8.0E-09	8.0E-10	2.9E-06	0	3.0E-06	*58.372*	0	0	0	0	0	*0.00*
TOTALS	1.1E-06	9.6E-07	2.9E-06	1.4E-08	**5.1E-06**	*100*	3.8E-02	2.4E-02	0.0E+00	0.0E+00	**6.1E-02**	*100*
% of Total Risk or HI	22.6	18.9	58.2	0.3		100.0	61.7	38.3	0	0		100.0

Table H-49

Carcinogenic and Noncarcinogenic Risk Estimates for Current Long-Term On-Base Worker (chronic) Attributable to Fire Protection Training Area: Average Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways		Total Risk	% of Total Risk	Surface Soil Pathways		Inhalation Pathways		Hazard Index	% of Total Index
	Dermal Contact	Ingestion	Vapors	Dust			Dermal Contact	Ingestion	Vapors	Dust		
Dioxins												
HpCDD Totals	9.8E-08	1.6E-08	0	2.2E-15	1.1E-07	*17.76*	0	0	0	0	0	*0.00*
OCDD	6.4E-08	1.1E-08	0	1.4E-15	7.5E-08	*11.61*	0	0	0	0	0	*0.00*
Metals	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Lead	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
PNAs	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Acenaphthylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	1.3E-08	0	0	1.3E-08	*2.05*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
4,4'-DDT	8.6E-08	1.4E-08	0	2.6E-09	1.0E-07	*15.88*	1.4E-03	2.3E-04	0	0	1.6E-03	*11.82*
Aldrin	1.0E-07	1.7E-08	0	3.0E-09	1.2E-07	*18.72*	5.5E-04	9.2E-05	0	0	6.5E-04	*4.64*
Heptachlor epoxide	1.7E-08	2.9E-09	0	5.2E-10	2.1E-08	*3.25*	4.1E-04	6.9E-05	0	0	4.8E-04	*3.47*
Semi-Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Hexanone	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzene	0	0	2.0E-07	0	2.0E-07	*30.73*	0	0	1.1E-02	0	1.1E-02	*80.07*
TOTALS	3.7E-07	7.4E-08	2.0E-07	6.1E-09	**6.4E-07**	*100*	2.4E-03	4.0E-04	1.1E-02	0.0E+00	**1.4E-02**	*100*
% of Total Risk or HI	56.8	11.5	30.7	0.9		100.0	17.1	2.8	80.1	0.0		100.0

Table H-50

Carcinogenic and Noncarcinogenic Risk Estimates for Current Long-Term On-Base Worker (chronic) Attributable to Fire Protection Training Area: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways		Total Risk	% of Total Risk	Surface Soil Pathways		Inhalation Pathways		Hazard Index	% of Total Index
	Dermal Contact	Ingestion	Vapors	Dust			Dermal Contact	Ingestion	Vapors	Dust		
Dioxins												
HpCDD Totals	1.6E-07	1.6E-08	0	6.5E-15	1.8E-07	*13.868*	0	0	0	0	0	*0.000*
OCDD	1.1E-07	1.1E-08	0	4.3E-15	1.2E-07	*9.063*	0	0	0	0	0	*0.000*
Metals	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Lead	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
PNAs	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Acenaphthylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Benzo(a)pyrene	0	1.3E-08	0	0	1.3E-08	*1.021*	0	0	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Phenanthrene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Pesticides	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
4,4'-DDT	1.4E-07	1.4E-08	0	7.7E-09	1.6E-07	*12.681*	2.3E-03	2.3E-04	0	0	2.6E-03	*6.838*
Aldrin	1.7E-07	1.7E-08	0	9.1E-09	1.9E-07	*14.950*	9.2E-04	9.2E-05	0	0	1.0E-03	*2.686*
Heptachlor epoxide	2.9E-08	2.9E-09	0	1.6E-09	3.4E-08	*2.593*	6.9E-04	6.9E-05	0	0	7.6E-04	*2.009*
Semi-Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
2-Hexanone	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Benzene	0	0	5.9E-07	0	5.9E-07	*45.824*	0	0	3.3E-02	0	3.3E-02	*88.467*
TOTALS	6.1E-07	7.4E-08	5.9E-07	1.8E-08	**1.3E-06**	*100*	4.0E-03	4.0E-04	3.3E-02	0.0E+00	**3.8E-02**	*100*
% of Total Risk or HI	47.0	5.7	45.8	1.4		100.0	10.5	1.0	88.5	0.0		100.0

Table H-51

Carcinogenic and Noncarcinogenic Risk Estimates for Current Long-Term On-Base Worker (chronic) Attributable to POL Tank Farm: Average Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways		Total Risk	% of Total Risk	Surface Soil Pathways		Inhalation Pathways		Hazard Index	% of Total Index
	Dermal Contact	Ingestion	Vapors	Dust			Dermal Contact	Ingestion	Vapors	Dust		
Metals												
Lead	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
PNAs	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
2-Methylnaphthalene	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
Benz(a)anthracene	0	3.6E-09	0	0	3.6E-09	*0.1*	0	0	0	0	0	*0.0*
Benzo(a)pyrene	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
Benzo(b)fluoranthene	0	3.0E-09	0	0	3.0E-09	*0.1*	0	0	0	0	0	*0.0*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
Dibenz(a,h)anthracene	0	1.3E-08	0	0	1.3E-08	*0.4*	0	0	0	0	0	*0.0*
Phenanthrene	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
Pesticides	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
Dieldrin	1.2E-07	2.0E-08	0	8.8E-11	1.4E-07	*4.6*	4.1E-04	6.9E-05	0	0	4.8E-04	*0.3*
Volatiles	0	0	0	0	0	*0.0*	0	0	0	0	0	*0.0*
Benzene	0	0	2.9E-06	0	2.9E-06	*94.8*	0	0	1.6E-01	0	1.6E-01	*99.7*
TOTALS	1.2E-07	3.9E-08	2.9E-06	8.8E-11	**3.0E-06**	*100*	4.1E-04	6.9E-05	1.6E-01	0.0E+00	**1.6E-01**	*100*
% of Total Risk or HI	3.9	1.3	94.8	0.0		100.0	0.3	0.0	99.7	0.0		100.0

Table H-52
Carcinogenic and Noncarcinogenic Risk Estimates for Current Long-Term On-Base Worker (chronic) Attributable to POL Tank Farm: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway: Surface Soil Pathways: Dermal Contact	Cancer Risk By Pathway: Surface Soil Pathways: Ingestion	Cancer Risk By Pathway: Inhalation Pathways: Vapors	Cancer Risk By Pathway: Inhalation Pathways: Dust	Total Risk	% of Total Risk	Hazard Index By Pathway: Surface Soil Pathways: Dermal Contact	Hazard Index By Pathway: Surface Soil Pathways: Ingestion	Hazard Index By Pathway: Inhalation Pathways: Vapors	Hazard Index By Pathway: Inhalation Pathways: Dust	Hazard Index	% of Total Index
Metals												
Lead	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
PNAs	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benz(a)anthracene	0	3.6E-09	0	0	3.6E-09	*0.04*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	2.4E-08	0	0	2.4E-08	*0.28*	0	0	0	0	0	*0.00*
Benzo(b)fluoranthene	0	3.0E-09	0	0	3.0E-09	*0.03*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	1.3E-08	0	0	1.3E-08	*0.14*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Dieldrin	2.0E-07	2.0E-08	0	2.6E-10	2.2E-07	*2.45*	6.9E-04	6.9E-05	0	0	7.6E-04	*0.16*
Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzene	0	0	8.6E-06	0	8.6E-06	*97.05*	0	0	4.8E-01	0	4.8E-01	*99.84*
TOTALS	2.0E-07	6.3E-08	8.6E-06	2.6E-10	**8.8E-06**	*100*	6.9E-04	6.9E-05	4.8E-01	0.0E+00	**4.8E-01**	*100*
% of Total Risk or HI	2.2	0.7	97.1	0.0		100.0	0.1	0.0	99.8	0.0		100.0

Table H-53

Carcinogenic and Noncarcinogenic Risk Estimates for Current Long-Term On-Base Worker (chronic) Attributable to West Unit: Average Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways				Surface Soil Pathways		Inhalation Pathways			
	Dermal Contact	Ingestion	Vapors	Dust	Total Risk	% of Total Risk	Dermal Contact	Ingestion	Vapors	Dust	Hazard Index	% of Total Index
Metals												
Aluminum	0	0	0	0	0	*0.00*	1.9E-03	3.2E-03	0	0	5.1E-03	*1.493*
Arsenic	2.1E-06	3.4E-06	0	2.2E-08	5.5E-06	*41.90*	1.3E-02	2.1E-02	0	0	3.4E-02	*10.027*
Beryllium	0	8.1E-08	0	1.8E-10	8.1E-08	*0.62*	0	1.1E-05	0	0	1.1E-05	*0.003*
Lead	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.000*
Manganese (food/dust)	0	0	0	0	0	*0.00*	3.0E-04	4.9E-04	0	1.3E-02	1.4E-02	*4.026*
PNAs	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.000*
2-Methylnaphthalene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.000*
Acenaphthylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.000*
Benz(a)anthracene	0	7.7E-08	0	0	7.7E-08	*0.59*	0	0	0	0	0	*0.000*
Benzo(a)pyrene	0	6.6E-07	0	0	6.6E-07	*5.01*	0	0	0	0	0	*0.000*
Benzo(b)fluoranthene	0	9.4E-08	0	0	9.4E-08	*0.72*	0	0	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.000*
Benzo(k)fluoranthene	0	8.1E-09	0	0	8.1E-09	*0.06*	0	0	0	0	0	*0.000*
Chrysene	0	8.4E-10	0	0	8.4E-10	*0.01*	0	0	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	1.7E-07	0	0	1.7E-07	*1.32*	0	0	0	0	0	*0.000*
Indeno(1,2,3-cd)pyrene	0	3.2E-08	0	0	3.2E-08	*0.25*	0	0	0	0	0	*0.000*
Phenanthrene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.000*
Pesticides	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.000*
4,4'-DDD	2.1E-07	3.5E-08	0	0	2.4E-07	*1.85*	0	0	0	0	0	*0.000*
4,4'-DDE	4.0E-08	6.7E-09	0	0	4.7E-08	*0.36*	0	0	0	0	0	*0.000*
4,4'-DDT	4.7E-07	7.8E-08	0	2.3E-10	5.4E-07	*4.14*	7.7E-03	1.3E-03	0	0	9.0E-03	*2.630*
Aldrin	2.6E-08	4.3E-09	0	1.2E-11	3.0E-08	*0.23*	1.4E-04	2.4E-05	0	0	1.6E-04	*0.048*
alpha-BHC	1.8E-08	3.0E-09	0	3.8E-12	2.1E-08	*0.16*	0	0	0	0	0	*0.000*
Dieldrin	5.7E-07	9.4E-08	0	2.7E-10	6.6E-07	*5.02*	2.0E-03	3.3E-04	0	0	2.3E-03	*0.678*
gamma-BHC	5.2E-09	8.7E-10	0	0	6.1E-09	*0.05*	3.7E-05	6.2E-06	0	0	4.4E-05	*0.013*
Heptachlor epoxide	5.2E-09	8.7E-10	0	9.9E-13	6.1E-09	*0.05*	1.2E-04	2.0E-05	0	0	1.4E-04	*0.042*
Semi-Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.000*
2-Hexanone	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.000*
Pentachlorophenol	1.5E-08	2.5E-09	0	0	1.7E-08	*0.13*	1.1E-05	1.9E-06	0	0	1.3E-05	*0.004*
Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.000*
1,1,2,2-Tetrachloroethane	0	0	2.9E-09	0	2.9E-09	*0.02*	0	0	0	0	0	*0.000*
Benzene	2.4E-08	4.0E-09	4.9E-06	0	4.9E-06	*37.54*	0	0	2.8E-01	0	2.8E-01	*81.036*
TOTALS	3.4E-06	4.8E-06	4.9E-06	2.3E-08	**1.3E-05**	*100*	2.5E-02	2.7E-02	2.8E-01	1.3E-02	**3.4E-01**	*100*
% of Total Risk or HI	26.1	36.4	37.3	0.2		100.0	7.3	7.8	81.0	3.8		100.0

Table H-54
Carcinogenic and Noncarcinogenic Risk Estimates for Current Long-Term On-Base Worker (chronic) Attributable to West Unit: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway: Surface Soil Pathways: Dermal Contact	Cancer Risk By Pathway: Surface Soil Pathways: Ingestion	Cancer Risk By Pathway: Inhalation Pathways: Vapors	Cancer Risk By Pathway: Inhalation Pathways: Dust	Total Risk	% of Total Risk	Hazard Index By Pathway: Surface Soil Pathways: Dermal Contact	Hazard Index By Pathway: Surface Soil Pathways: Ingestion	Hazard Index By Pathway: Inhalation Pathways: Vapors	Hazard Index By Pathway: Inhalation Pathways: Dust	Hazard Index	% of Total Index
Metals												
Aluminum	0	0	0	0	0	*0.000*	3.2E-03	3.2E-03	0	0	6.4E-03	*0.679*
Arsenic	3.4E-06	3.4E-06	0	6.7E-08	6.9E-06	*27.367*	2.1E-02	2.1E-02	0	0	4.3E-02	*4.564*
Beryllium	0	8.1E-08	0	5.3E-10	8.2E-08	*0.323*	0	1.1E-05	0	0	1.1E-05	*0.001*
Lead	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Manganese (food/dust)	0	0	0	0	0	*0.000*	4.9E-04	4.9E-04	0	3.9E-02	4.0E-02	*4.252*
PNAs	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
2-Methylnaphthalene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Acenaphthylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Benz(a)anthracene	0	7.7E-08	0	0	7.7E-08	*0.306*	0	0	0	0	0	*0.000*
Benzo(a)pyrene	0	6.6E-07	0	0	6.6E-07	*2.605*	0	0	0	0	0	*0.000*
Benzo(b)fluoranthene	0	9.4E-08	0	0	9.4E-08	*0.373*	0	0	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Benzo(k)fluoranthene	0	8.1E-09	0	0	8.1E-09	*0.032*	0	0	0	0	0	*0.000*
Chrysene	0	8.4E-10	0	0	8.4E-10	*0.003*	0	0	0	0	0	*0.000*
Dibenz(a,h)anthracene	0	1.7E-07	0	0	1.7E-07	*0.684*	0	0	0	0	0	*0.000*
Indeno(1,2,3-cd)pyrene	0	3.2E-08	0	0	3.2E-08	*0.128*	0	0	0	0	0	*0.000*
Phenanthrene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Pesticides	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
4,4'-DDD	3.5E-07	3.5E-08	0	0	3.8E-07	*1.507*	0	0	0	0	0	*0.000*
4,4'-DDE	6.7E-08	6.7E-09	0	0	7.4E-08	*0.292*	0	0	0	0	0	*0.000*
4,4'-DDT	7.8E-07	7.8E-08	0	7.0E-10	8.6E-07	*3.379*	1.3E-02	1.3E-03	0	0	1.4E-02	*1.505*
Aldrin	4.3E-08	4.3E-09	0	3.6E-11	4.7E-08	*0.186*	2.4E-04	2.4E-05	0	0	2.6E-04	*0.028*
alpha-BHC	3.0E-08	3.0E-09	0	1.1E-11	3.3E-08	*0.129*	0	0	0	0	0	*0.000*
Dieldrin	9.4E-07	9.4E-08	0	8.2E-10	1.0E-06	*4.097*	3.3E-03	3.3E-04	0	0	3.6E-03	*0.388*
gamma-BHC	8.7E-09	8.7E-10	0	0	9.6E-09	*0.038*	6.2E-05	6.2E-06	0	0	6.9E-05	*0.007*
Heptachlor epoxide	8.7E-09	8.7E-10	0	3.0E-12	9.5E-09	*0.038*	2.0E-04	2.0E-05	0	0	2.3E-04	*0.024*
Semi-Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
2-Hexanone	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Pentachlorophenol	2.5E-08	2.5E-09	0	0	2.7E-08	*0.107*	1.9E-05	1.9E-06	0	0	2.1E-05	*0.002*
Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
1,1,2,2-Tetrachloroethane	0	0	8.6E-09	0	8.6E-09	*0.034*	0	0	0	0	0	*0.000*
Benzene	4.0E-08	4.0E-09	1.5E-05	0	1.5E-05	*58.372*	0	0	8.3E-01	0	8.3E-01	*88.550*
TOTALS	5.7E-06	4.8E-06	1.5E-05	6.9E-08	**2.5E-05**	*100*	4.2E-02	2.7E-02	8.3E-01	3.9E-02	**9.4E-01**	*100*
% of Total Risk or HI	22.6	18.9	58.2	0.3		100.0	4.5	2.9	88.6	4.1		100.0

Table H-55

Carcinogenic and Noncarcinogenic Risk Estimates for Current On-Base Construction Worker (subchronic) Attributable to Fire Protection Training Area: Average Exposure Scenario

Analyte	Cancer Risk By Pathway: Mixed Soil Pathways: Dermal Absorption	Cancer Risk By Pathway: Mixed Soil Pathways: Ingestion	Cancer Risk By Pathway: Inhalation Pathways: Vapors	Cancer Risk By Pathway: Inhalation Pathways: Dust	Total Risk	% of Total Risk	Hazard Index By Pathway: Mixed Soil Pathways: Dermal Absorption	Hazard Index By Pathway: Mixed Soil Pathways: Ingestion	Hazard Index By Pathway: Inhalation Pathways: Vapors	Hazard Index By Pathway: Inhalation Pathways: Dust	Hazard Index	% of Total Index
Dioxins												
HpCDD Totals	1.7E-09	2.8E-10	0	1.4E-16	2.0E-09	*0.08*	0	0	0	0	0	*0.00*
OCDD	1.1E-09	1.9E-10	0	9.2E-17	1.3E-09	*0.05*	0	0	0	0	0	*0.00*
Metals	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Lead	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
PNAs	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Acenaphthylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benz(a)anthracene	0	5.9E-10	0	0	5.9E-10	*0.02*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	4.0E-09	0	0	4.0E-09	*0.15*	0	0	0	0	0	*0.00*
Benzo(b)fluoranthene	0	2.5E-10	0	0	2.5E-10	*0.01*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	2.1E-10	0	0	2.1E-10	*0.01*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
4,4'-DDT	1.5E-09	2.5E-10	0	1.6E-10	1.9E-09	*0.07*	2.4E-03	4.1E-04	0	0	2.8E-03	*59.29*
Aldrin	1.7E-09	2.9E-10	0	2.0E-10	2.2E-09	*0.09*	9.6E-04	1.6E-04	0	0	1.1E-03	*23.29*
Heptachlor epoxide	3.0E-10	5.1E-11	0	3.4E-11	3.9E-10	*0.01*	7.2E-04	1.2E-04	0	0	8.4E-04	*17.42*
Semi-Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Hexanone	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzene	8.9E-09	1.5E-09	2.6E-06	0	2.6E-06	*99.50*	0	0	0	0	0	*0.00*
TOTALS	1.5E-08	7.6E-09	2.6E-06	4.0E-10	**2.6E-06**	*100*	4.1E-03	6.9E-04	0.0E+00	0.0E+00	**4.8E-03**	*100*
% of Total Risk or HI	0.6	0.3	99.1	0.0		100.0	85.7	14.3	0.0	0.0		100.0

Tabe H-56
Carcinogenic and Noncarcinogenic Risk Estimates for Current On-Base Construction Worker (subchronic) Attributable to Fire Protection Training Area: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Mixed Soil Pathways		Inhalation Pathways		Total Risk	% of Total Risk	Mixed Soil Pathways		Inhalation Pathways		Hazard Index	% of Total Index
	Dermal Absorption	Ingestion	Vapors	Dust			Dermal Absorption	Ingestion	Vapors	Dust		
Dioxins												
HpCDD Totals	5.7E-09	5.4E-09	0	2.9E-16	1.1E-08	*0.204*	0	0	0	0	0	*0.00*
OCDD	3.7E-09	3.6E-09	0	1.9E-16	7.3E-09	*0.133*	0	0	0	0	0	*0.00*
Metals	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Lead	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
PNAs	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Acenaphthylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Benz(a)anthracene	0	1.1E-08	0	0	1.1E-08	*0.207*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	7.6E-08	0	0	7.6E-08	*1.397*	0	0	0	0	0	*0.00*
Benzo(b)fluoranthene	0	4.8E-09	0	0	4.8E-09	*0.089*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	4.1E-09	0	0	4.1E-09	*0.075*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
4,4'-DDT	4.9E-09	4.7E-09	0	3.4E-10	1.0E-08	*0.184*	4.1E-03	3.9E-03	0	0	8.0E-03	*59.29*
Aldrin	5.8E-09	5.6E-09	0	4.0E-10	1.2E-08	*0.217*	1.6E-03	1.5E-03	0	0	3.1E-03	*23.29*
Heptachlor epoxide	1.0E-09	9.7E-10	0	6.9E-11	2.1E-09	*0.038*	1.2E-03	1.1E-03	0	0	2.3E-03	*17.42*
Semi-Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
2-Hexanone	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Benzene	3.0E-08	2.9E-08	5.3E-06	0	5.3E-06	*97.458*	0	0	0	0	0	*0.00*
TOTALS	5.1E-08	1.5E-07	5.3E-06	8.1E-10	**5.5E-06**	*100*	6.9E-03	6.6E-03	0.0E+00	0.0E+00	**1.3E-02**	*100*
% of Total Risk or HI	0.9	2.7	96.4	0.0		100.0	51.0	49.0	0.0	0.0		100.0

Table H-57

Carcinogenic and Noncarcinogenic Risk Estimates for Current On-Base Construction Worker (subchronic) Attributable to POL Tank Farm: Average Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Mixed Soil Pathways		Inhalation Pathways		Total Risk	% of Total Risk	Mixed Soil Pathways		Inhalation Pathways		Hazard Index	% of Total Index
	Dermal Absorption	Ingestion	Vapors	Dust			Dermal Absorption	Ingestion	Vapors	Dust		
Metals												
Lead	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.0*
PNAs	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.0*
2-Methylnaphthalene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.0*
Benz(a)anthracene	0	6.3E-11	0	0	6.3E-11	*0.0001*	0	0	0	0	0	*0.0*
Benzo(a)pyrene	0	4.2E-10	0	0	4.2E-10	*0.0008*	0	0	0	0	0	*0.0*
Benzo(b)fluoranthene	0	5.3E-11	0	0	5.3E-11	*0.0001*	0	0	0	0	0	*0.0*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.0*
Dibenz(a,h)anthracene	0	2.2E-10	0	0	2.2E-10	*0.0004*	0	0	0	0	0	*0.0*
Phenanthrene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.0*
Pesticides	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.0*
Dieldrin	2.0E-09	3.4E-10	0	-2.1E-10	2.6E-09	*0.0046*	7.1E-04	1.2E-04	0	0	8.3E-04	*100.0*
Volatiles	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.0*
Benzene	1.1E-07	1.8E-08	5.6E-05	0	5.6E-05	*99.9940*	0	0	0	0	0	*0.0*
TOTALS	1.1E-07	1.9E-08	5.6E-05	2.1E-10	**5.6E-05**	*100*	7.1E-04	1.2E-04	0.0E+00	0.0E+00	**8.3E-04**	*100*
% of Total Risk or HI	0.2	0.0	99.8	0.0		100.0	85.7	14.3	0.0	0.0		100.0

Table H-58

Carcinogenic and Noncarcinogenic Risk Estimates for Current On-Base Construction Worker (subchronic) Attributable to POL Tank Farm: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Mixed Soil Pathways		Inhalation Pathways		Total Risk	% of Total Risk	Mixed Soil Pathways		Inhalation Pathways		Hazard Index	% of Total Index
	Dermal Absorption	Ingestion	Vapors	Dust			Dermal Absorption	Ingestion	Vapors	Dust		
Metals												
Lead	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.0*
PNAs	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.0*
2-Methylnaphthalene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.0*
Benz(a)anthracene	0	1.2E-09	0	0	1.2E-09	*0.001*	0	0	0	0	0	*0.0*
Benzo(a)pyrene	0	8.1E-09	0	0	8.1E-09	*0.007*	0	0	0	0	0	*0.0*
Benzo(b)fluoranthene	0	1.0E-09	0	0	1.0E-09	*0.001*	0	0	0	0	0	*0.0*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.0*
Dibenz(a,h)anthracene	0	4.2E-09	0	0	4.2E-09	*0.004*	0	0	0	0	0	*0.0*
Phenanthrene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.0*
Pesticides	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.0*
Dieldrin	6.8E-09	6.5E-09	0	4.3E-10	1.4E-08	*0.012*	1.2E-03	1.1E-03	0	0	2.3E-03	*100.0*
Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.0*
Benzene	3.6E-07	3.4E-07	1.1E-04	0	1.2E-04	*99.975*	0	0	0	0	0	*0.0*
TOTALS	3.7E-07	3.7E-07	1.1E-04	4.3E-10	**1.2E-04**	*100*	1.2E-03	1.1E-03	0.0E+00	0.0E+00	**2.3E-03**	*100*
% of Total Risk or HI	0.3	0.3	99.4	0.0		100.0	51.0	49.0	0.0	0.0		100.0

Table H-59

Carcinogenic and Noncarcinogenic Risk Estimates for Current On-Base Construction Worker (subchronic) Attributable to West Unit: Average Exposure Scenario

Analyte	Cancer Risk By Pathway: Mixed Soil Pathways: Dermal Absorption	Cancer Risk By Pathway: Mixed Soil Pathways: Ingestion	Cancer Risk By Pathway: Inhalation Pathways: Vapors	Cancer Risk By Pathway: Inhalation Pathways: Dust	Total Risk	% of Total Risk	Hazard Index By Pathway: Mixed Soil Pathways: Dermal Absorption	Hazard Index By Pathway: Mixed Soil Pathways: Ingestion	Hazard Index By Pathway: Inhalation Pathways: Vapors	Hazard Index By Pathway: Inhalation Pathways: Dust	Hazard Index	% of Total Index
Metals												
Aluminum	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Arsenic	3.6E-08	5.9E-08	0	6.7E-08	1.6E-07	*13.731*	2.2E-02	3.7E-02	0	0	5.9E-02	*72.69*
Beryllium	0	2.2E-09	0	1.2E-09	3.4E-09	*0.287*	0	2.9E-05	0	0	2.9E-05	*0.04*
Lead	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Manganese(food/dust)	0	0	0	0	0	*0.000*	0	1.6E-03	0	0	1.6E-03	*1.97*
PNAs	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Acenaphthylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Benz(a)anthracene	0	1.3E-09	0	0	1.3E-09	*0.114*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	1.1E-08	0	0	1.1E-08	*0.969*	0	0	0	0	0	*0.00*
Benzo(b)fluoranthene	0	1.6E-09	0	0	1.6E-09	*0.139*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Benzo(k)fluoranthene	0	1.4E-10	0	0	1.4E-10	*0.012*	0	0	0	0	0	*0.00*
Chrysene	0	1.5E-11	0	0	1.5E-11	*0.001*	0	0	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	3.0E-09	0	0	3.0E-09	*0.254*	0	0	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	5.6E-10	0	0	5.6E-10	*0.048*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
4,4'-DDD	5.5E-09	9.2E-10	0	0	6.5E-09	*0.548*	0	0	0	0	0	*0.00*
4,4'-DDE	7.0E-10	1.2E-10	0	0	8.1E-10	*0.069*	0	0	0	0	0	*0.00*
4,4'-DDT	8.1E-09	1.3E-09	0	6.4E-10	1.0E-08	*0.854*	1.3E-02	2.2E-03	0	0	1.6E-02	*19.07*
Aldrin	4.5E-10	7.4E-11	0	2.4E-11	5.4E-10	*0.046*	2.4E-04	4.1E-05	0	0	2.9E-04	*0.35*
alpha-BHC	3.1E-10	5.2E-11	0	7.3E-12	3.7E-10	*0.031*	0	0	0	0	0	*0.00*
Dieldrin	9.8E-09	1.6E-09	0	5.6E-10	1.2E-08	*1.017*	3.4E-03	5.7E-04	0	0	4.0E-03	*4.91*
gamma-BHC	1.5E-10	2.4E-11	0	0	1.7E-10	*0.014*	1.0E-05	1.7E-06	0	0	1.2E-05	*0.01*
Heptachlor epoxide	2.7E-10	4.6E-11	0	9.9E-12	3.3E-10	*0.028*	6.5E-04	1.1E-04	0	0	7.6E-04	*0.93*
Semi-Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
2-Hexanone	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
bis(2-Ethylhexyl)phthalate	7.5E-10	1.2E-10	0	2.4E-11	9.0E-10	*0.076*	0	0	0	0	0	*0.00*
Pentachlorophenol	2.6E-10	4.3E-11	0	0	3.0E-10	*0.025*	2.0E-05	3.3E-06	0	0	2.3E-05	*0.03*
Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	5.2E-10	8.7E-11	4.4E-08	0	4.5E-08	*3.782*	0	0	0	0	0	*0.00*
Benzene	4.2E-09	7.0E-10	9.2E-07	0	9.2E-07	*77.957*	0	0	0	0	0	*0.00*
TOTALS	6.7E-08	8.5E-08	9.6E-07	6.9E-08	**1.2E-06**	*100*	4.0E-02	4.2E-02	0.0E+00	0.0E+00	**8.1E-02**	*100*
% of Total Risk or HI	5.7	7.2	81.3	5.9		100.0	48.9	51.1	0.0	0.0		100.0

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Table H-60

Carcinogenic and Noncarcinogenic Risk Estimates for Current On-Base Construction Worker (subchronic) Attributable to West Unit: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway: Mixed Soil Pathways: Dermal Absorption	Cancer Risk: Mixed Soil Pathways: Ingestion	Cancer Risk: Inhalation Pathways: Vapors	Cancer Risk: Inhalation Pathways: Dust	Total Risk	% of Total Risk	Hazard Index By Pathway: Mixed Soil Pathways: Dermal Absorption	Hazard Index: Mixed Soil Pathways: Ingestion	Hazard Index: Inhalation Pathways: Vapors	Hazard Index: Inhalation Pathways: Dust	Hazard Index	% of Total Index
Metals												
Aluminum	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Arsenic	1.2E-07	1.1E-06	0	1.4E-07	1.4E-06	*35.30*	3.7E-02	3.6E-01	0	0	3.9E-01	*84.24*
Beryllium	0	4.2E-08	0	2.4E-09	4.5E-08	*1.13*	0	2.8E-04	0	0	2.8E-04	*0.06*
Lead	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Manganese (food/dust)	0	0	0	0	0	*0.00*	0	1.5E-02	0	0	1.5E-02	*3.31*
PNAs	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Acenaphthylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benz(a)anthracene	0	2.6E-08	0	0	2.6E-08	*0.65*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	2.2E-07	0	0	2.2E-07	*5.54*	0	0	0	0	0	*0.00*
Benzo(b)fluoranthene	0	3.1E-08	0	0	3.1E-08	*0.79*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzo(k)fluoranthene	0	2.7E-09	0	0	2.7E-09	*0.07*	0	0	0	0	0	*0.00*
Chrysene	0	2.8E-10	0	0	2.8E-10	*0.01*	0	0	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	5.8E-08	0	0	5.8E-08	*1.45*	0	0	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	1.1E-08	0	0	1.1E-08	*0.27*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
4,4'-DDD	1.8E-08	1.8E-08	0	0	3.6E-08	*0.91*	0	0	0	0	0	*0.00*
4,4'-DDE	2.3E-09	2.2E-09	0	0	4.6E-09	*0.12*	0	0	0	0	0	*0.00*
4,4'-DDT	2.7E-08	2.6E-08	0	1.3E-09	5.4E-08	*1.37*	2.2E-02	2.1E-02	0	0	4.3E-02	*9.34*
Aldrin	1.5E-09	1.4E-09	0	5.0E-11	3.0E-09	*0.07*	4.1E-04	3.9E-04	0	0	8.0E-04	*0.17*
alpha-BHC	1.0E-09	9.9E-10	0	1.5E-11	2.0E-09	*0.05*	0	0	0	0	0	*0.00*
Dieldrin	3.3E-08	3.1E-08	0	1.2E-09	6.5E-08	*1.65*	5.7E-03	5.5E-03	0	0	1.1E-02	*2.41*
gamma-BHC	4.8E-10	4.6E-10	0	0	9.5E-10	*0.02*	1.7E-05	1.7E-05	0	0	3.4E-05	*0.01*
Heptachlor epoxide	9.1E-10	8.8E-10	0	2.0E-11	1.8E-09	*0.05*	1.1E-03	1.0E-03	0	0	2.1E-03	*0.45*
Semi-Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Hexanone	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
bis(2-Ethylhexyl)phthalate	2.5E-09	2.4E-09	0	4.9E-11	4.9E-09	*0.12*	0	0	0	0	0	*0.00*
Pentachlorophenol	8.5E-10	8.2E-10	0	0	1.7E-09	*0.04*	3.3E-05	3.2E-05	0	0	6.5E-05	*0.01*
Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	1.7E-09	1.7E-09	9.0E-08	0	9.3E-08	*2.35*	0	0	0	0	0	*0.00*
Benzene	1.4E-08	1.3E-08	1.9E-06	0	1.9E-06	*48.02*	0	0	0	0	0	*0.00*
TOTALS	2.2E-07	1.6E-06	2.0E-06	1.4E-07	**4.0E-06**	*100*	6.6E-02	4.0E-01	0.0E+00	0.0E+00	**4.7E-01**	*100*
% of Total Risk or HI	5.6	41.2	49.6	3.6		100.0	14.3	85.7	0.0	0.0		100.0

Table H-61

Carcinogenic and Noncarcinogenic Risk Estimates for Future Boarding School Student (subchronic) Attributable to Fire Protection Training Area: Average Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways				Surface Soil Pathways		Inhalation Pathways			
	Dermal Contact	Ingestion	Vapors	Dust	Total Risk	% of Total Risk	Dermal Contact	Ingestion	Vapors	Dust	Hazard Index	% of Total Index
Dioxins												
HpCDD Totals	0	0	0	1.2E-19	1.2E-19	*0.000*	0	0	0	0	0	*#DIV/0!*
OCDD	0	0	0	7.8E-20	7.8E-20	*0.000*	0	0	0	0	0	*#DIV/0!*
Metals	0	0	0	0	0	*0.000*	0	0	0	0	0	*#DIV/0!*
Lead	0	0	0	0	0	*0.000*	0	0	0	0	0	*#DIV/0!*
PNAs	0	0	0	0	0	*0.000*	0	0	0	0	0	*#DIV/0!*
Acenaphthylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*#DIV/0!*
Benzo(a)pyrene	0	0	0	0	0	*0.000*	0	0	0	0	0	*#DIV/0!*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*#DIV/0!*
Phenanthrene	0	0	0	0	0	*0.000*	0	0	0	0	0	*#DIV/0!*
Pesticides	0	0	0	0	0	*0.000*	0	0	0	0	0	*#DIV/0!*
4,4-DDT	0	0	0	1.4E-13	1.4E-13	*1.250*	0	0	0	0	0	*#DIV/0!*
Aldrin	0	0	0	1.7E-13	1.7E-13	*1.488*	0	0	0	0	0	*#DIV/0!*
Heptachlor epoxide	0	0	0	2.9E-14	2.9E-14	*0.256*	0	0	0	0	0	*#DIV/0!*
Semi-Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*#DIV/0!*
2-Hexanone	0	0	0	0	0	*0.000*	0	0	0	0	0	*#DIV/0!*
Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*#DIV/0!*
Benzene	0	0	1.1E-11	0	1.1E-11	*97.006*	0	0	0	0	0	*#DIV/0!*
TOTALS	0.0E+00	0.0E+00	1.1E-11	3.4E-13	**1.1E-11**	*100*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	*#DIV/0!*
% of Total Risk or HI	0.0	0.0	97.0	3.0		100.0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!

Table H-62
Carcinogenic and Noncarcinogenic Risk Estimates for Future Boarding School Student (chronic) Attributable to Fire Protection Training Area: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway: Surface Soil Pathways		Cancer Risk By Pathway: Inhalation Pathways				Hazard Index By Pathway: Surface Soil Pathways		Hazard Index By Pathway: Inhalation Pathways			
	Dermal Contact	Ingestion	Vapors	Dust	Total Risk	% of Total Risk	Dermal Contact	Ingestion	Vapors	Dust	Hazard Index	% of Total Index
Dioxins												
HpCDD Totals	0	0	0	4.2E-19	4.2E-19	*0.000*	0	0	0	0	0	*0.000*
OCDD	0	0	0	2.7E-19	2.7E-19	*0.000*	0	0	0	0	0	*0.000*
Metals	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Lead	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
PNAs	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Acenaphthylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Benzo(a)pyrene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Phenanthrene	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Pesticides	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
4,4-DDT	0	0	0	4.9E-13	4.9E-13	*1.250*	0	0	0	0	0	*0.000*
Aldrin	0	0	0	5.9E-13	5.9E-13	*1.488*	0	0	0	0	0	*0.000*
Heptachlor epoxide	0	0	0	1.0E-13	1.0E-13	*0.256*	0	0	0	0	0	*0.000*
Semi-Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
2-Hexanone	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Volatiles	0	0	0	0	0	*0.000*	0	0	0	0	0	*0.000*
Benzene	0	0	3.8E-11	0	3.8E-11	*97.006*	0	0	3.8E-06	0	3.8E-06	*100.000*
TOTALS	0.0E+00	0.0E+00	3.8E-11	1.2E-12	**4.0E-11**	*100*	0.0E+00	0.0E+00	3.8E-06	0.0E+00	**3.8E-06**	*100*
% of Total Risk or HI	0.0	0.0	97.0	3.0		100.0	0.0	0.0	100.0	0.0		100.0

Table H-63
Carcinogenic and Noncarcinogenic Risk Estimates for Future Boarding School Student (subchronic) Attributable to POL Tank Farm: Average Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways				Surface Soil Pathways		Inhalation Pathways			
	Dermal Contact	Ingestion	Vapors	Dust	Total Risk	% of Total Risk	Dermal Contact	Ingestion	Vapors	Dust	Hazard Index	% of Total Index
Metals												
Lead	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
PNAs	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Methylnapthalene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benz(a)anthracene	0	1.1E-09	0	0	1.1E-09	*0.25*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	7.1E-09	0	0	7.1E-09	*1.68*	0	0	0	0	0	*0.00*
Benzo(b)fluoranthene	0	8.9E-10	0	0	8.9E-10	*0.21*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	3.7E-09	0	0	3.7E-09	*0.87*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Dieldrin	1.5E-08	5.7E-09	0	1.2E-11	2.1E-08	*4.90*	3.3E-04	1.3E-04	0	0	4.6E-04	*100.00*
Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzene	0	0	3.9E-07	0	3.9E-07	*92.11*	0	0	0	0	0	*0.00*
TOTALS	1.5E-08	1.9E-08	3.9E-07	1.2E-11	**4.3E-07**	*100*	3.3E-04	1.3E-04	0.0E+00	0.0E+00	**4.6E-04**	*100*
% of Total Risk or HI	3.5	4.3	92.1	0.0		100.0	72.4	27.6	0.0	0.0		100.0

Table H-64
Carcinogenic and Noncarcinogenic Risk Estimates for Future Boarding School Student (chronic) Attributable to POL Tank Farm: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways		Total Risk	% of Total Risk	Surface Soil Pathways		Inhalation Pathways		Hazard Index	% of Total Index
	Dermal Contact	Ingestion	Vapors	Dust			Dermal Contact	Ingestion	Vapors	Dust		
Metals												
Lead	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
PNAs	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
2-Methylnapthalene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benz(a)anthracene	0	4.7E-09	0	0	4.7E-09	*0.30*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	3.1E-08	0	0	3.1E-08	*2.05*	0	0	0	0	0	*0.00*
Benzo(b)fluoranthene	0	3.9E-09	0	0	3.9E-09	*0.26*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	1.6E-08	0	0	1.6E-08	*1.06*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Dieldrin	7.9E-08	2.5E-08	0	4.2E-11	1.0E-07	*6.80*	4.9E-04	1.6E-04	0	0	6.5E-04	*0.47*
Volatiles	0	0	0	0	0	*0.00*	0	0	0	0	0	*0.00*
Benzene	0	0	1.4E-06	0	1.4E-06	*89.53*	0	0	1.4E-01	0	1.4E-01	*99.53*
TOTALS	7.9E-08	8.2E-08	1.4E-06	4.2E-11	**1.5E-06**	*100*	4.9E-04	1.6E-04	1.4E-01	0.0E+00	**1.4E-01**	*100*
% of Total Risk or HI	5.1	5.3	89.5	0.0		100.0	0.4	0.1	99.5	0.0		100.0

Table H-65
Carcinogenic and Noncarcinogenic Risk Estimates for Future Boarding School Student (subchronic) Attributable to West Unit: Average Exposure Scenario

Analyte	Cancer Risk By Pathway: Surface Soil Pathways: Dermal Contact	Cancer Risk By Pathway: Surface Soil Pathways: Ingestion	Cancer Risk By Pathway: Inhalation Pathways: Vapors	Cancer Risk By Pathway: Inhalation Pathways: Dust	Total Risk	% of Total Risk	Hazard Index By Pathway: Surface Soil Pathways: Dermal Contact	Hazard Index By Pathway: Surface Soil Pathways: Ingestion	Hazard Index By Pathway: Inhalation Pathways: Vapors	Hazard Index By Pathway: Inhalation Pathways: Dust	Hazard Index	% of Total Index
Metals												
Aluminum	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Arsenic	0	0	0	7.2E-12	7.2E-12	*0.0756*	0	0	0	0	0	*#DIV/0!*
Beryllium	0	0	0	5.0E-14	5.0E-14	*0.0005*	0	0	0	0	0	*#DIV/0!*
Lead	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Manganese (food)	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
PNAs	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
2-Methylnaphthalene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Acenaphthylene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Benz(a)anthracene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Benzo(a)pyrene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Benzo(b)fluoranthene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Benzo(k)fluoranthene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Chrysene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Dibenz(a,h)anthracene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Indeno(1,2,3-cd)pyrene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Phenanthrene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Pesticides	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
4,4-DDD	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
4,4-DDE	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
4,4-DDT	0	0	0	1.0E-12	1.0E-12	*0.0107*	0	0	0	0	0	*#DIV/0!*
Aldrin	0	0	0	7.5E-14	7.5E-14	*0.0008*	0	0	0	0	0	*#DIV/0!*
alpha-BHC	0	0	0	2.2E-15	2.2E-15	*0.0000*	0	0	0	0	0	*#DIV/0!*
Dieldrin	0	0	0	1.7E-12	1.7E-12	*0.0177*	0	0	0	0	0	*#DIV/0!*
gamma-BHC	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Heptachlor epoxide	0	0	0	6.2E-15	6.2E-15	*0.0001*	0	0	0	0	0	*#DIV/0!*
Semi-Volatiles	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
2-Hexanone	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Pentachlorophenol	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
Volatiles	0	0	0	0	0	*0.0000*	0	0	0	0	0	*#DIV/0!*
1,1,2,2-Tetrachloroethane	0	0	3.3E-11	0	3.3E-11	*0.3485*	0	0	0	0	0	*#DIV/0!*
Benzene	0	0	9.5E-09	0	9.5E-09	*99.5461*	0	0	0	0	0	*#DIV/0!*
TOTALS	0.0E+00	0.0E+00	9.6E-09	1.0E-11	**9.6E-09**	*100*	0.0E+00	0.0E+00	0.0E+00	0.0E+00	**0.0E+00**	*#DIV/0!*
% of Total Risk or HI	0.0	0.0	99.9	0.1		100.0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		#DIV/0!

Table H-66
Carcinogenic and Noncarcinogenic Risk Estimates for Future Boarding School Student (chronic) Attributable to West Unit: Reasonable Maximum Exposure Scenario

Analyte	Cancer Risk By Pathway						Hazard Index By Pathway					
	Surface Soil Pathways		Inhalation Pathways		Total Risk	% of Total Risk	Surface Soil Pathways		Inhalation Pathways		Hazard Index	% of Total Index
	Dermal Contact	Ingestion	Vapors	Dust			Dermal Contact	Ingestion	Vapors	Dust		
Metals												
Aluminum	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Arsenic	0	0	0	2.5E-11	2.5E-11	*0.0756*	0	0	0	0	0	*0.00*
Beryllium	0	0	0	1.8E-13	1.8E-13	*0.0005*	0	0	0	0	0	*0.00*
Lead	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Manganese (food)	0	0	0	0	0	*0.0000*	0	0	0	1.2E-05	1.2E-05	*0.34*
PNAs	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
2-Methylnaphthalene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Acenaphthylene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Benz(a)anthracene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Benzo(a)pyrene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Benzo(b)fluoranthene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Benzo(g,h,i)perylene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Benzo(k)fluoranthene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Chrysene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Dibenz(a,h)anthracene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Indeno(1,2,3-cd)pyrene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Phenanthrene	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Pesticides	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
4,4-DDD	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
4,4-DDE	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
4,4-DDT	0	0	0	3.6E-12	3.6E-12	*0.0107*	0	0	0	0	0	*0.00*
Aldrin	0	0	0	2.6E-13	2.6E-13	*0.0008*	0	0	0	0	0	*0.00*
alpha-BHC	0	0	0	7.6E-15	7.6E-15	*0.0000*	0	0	0	0	0	*0.00*
Dieldrin	0	0	0	5.9E-12	5.9E-12	*0.0177*	0	0	0	0	0	*0.00*
gamma-BHC	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Heptachlor epoxide	0	0	0	2.2E-14	2.2E-14	*0.0001*	0	0	0	0	0	*0.00*
Semi-Volatiles	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
2-Hexanone	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Pentachlorophenol	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
Volatiles	0	0	0	0	0	*0.0000*	0	0	0	0	0	*0.00*
1,1,2,2-Tetrachloroethane	0	0	1.2E-10	0	1.2E-10	*0.3485*	0	0	0	0	0	*0.00*
Benzene	0	0	3.3E-08	0	3.3E-08	*99.5461*	0	0	3.3E-03	0	3.3E-03	*99.66*
TOTALS	0.0E+00	0.0E+00	3.3E-08	3.5E-11	**3.4E-08**	*100*	0.0E+00	0.0E+00	3.3E-03	1.2E-05	**3.4E-03**	*100*
% of Total Risk or HI	0.0	0.0	99.9	0.1		100.0	0.0	0.0	99.7	0.3		100.0

LEAD MODEL Version 0.99d

AIR CONCENTRATION: 0.100 ug Pb/m3 DEFAULT
Indoor AIR Pb Conc: 30.0 percent of outdoor.
Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 11.00 ug Pb/L
WATER Consumption: DEFAULT

SOIL & DUST:
Soil: constant conc.
Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	86.0	86.0
1-2	86.0	86.0
2-3	86.0	86.0
3-4	86.0	86.0
4-5	86.0	86.0
5-6	86.0	86.0
6-7	86.0	86.0

Additional Dust Sources: None DEFAULT

PAINT Intake: 0.00 ug Pb/day DEFAULT

MATERNAL CONTRIBUTION: Infant Model
Maternal Blood Conc: 2.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	3.1	5.70	2.06
1-2:	3.5	8.50	3.23
2-3:	3.4	9.03	3.26
3-4:	3.2	9.06	3.29
4-5:	2.8	8.30	2.47
5-6:	2.6	8.43	2.23
6-7:	2.5	8.70	2.11

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	2.59	1.03	0.00	0.02
1-2:	2.68	2.55	0.00	0.03
2-3:	3.04	2.67	0.00	0.06
3-4:	2.95	2.75	0.00	0.07
4-5:	2.87	2.89	0.00	0.07
5-6:	3.04	3.06	0.00	0.09
6-7:	3.37	3.12	0.00	0.09

Table H-67
IEUBK Model Parameters for Estimating Blood Lead Concentrations in Resident Children at the POL Tank Farm

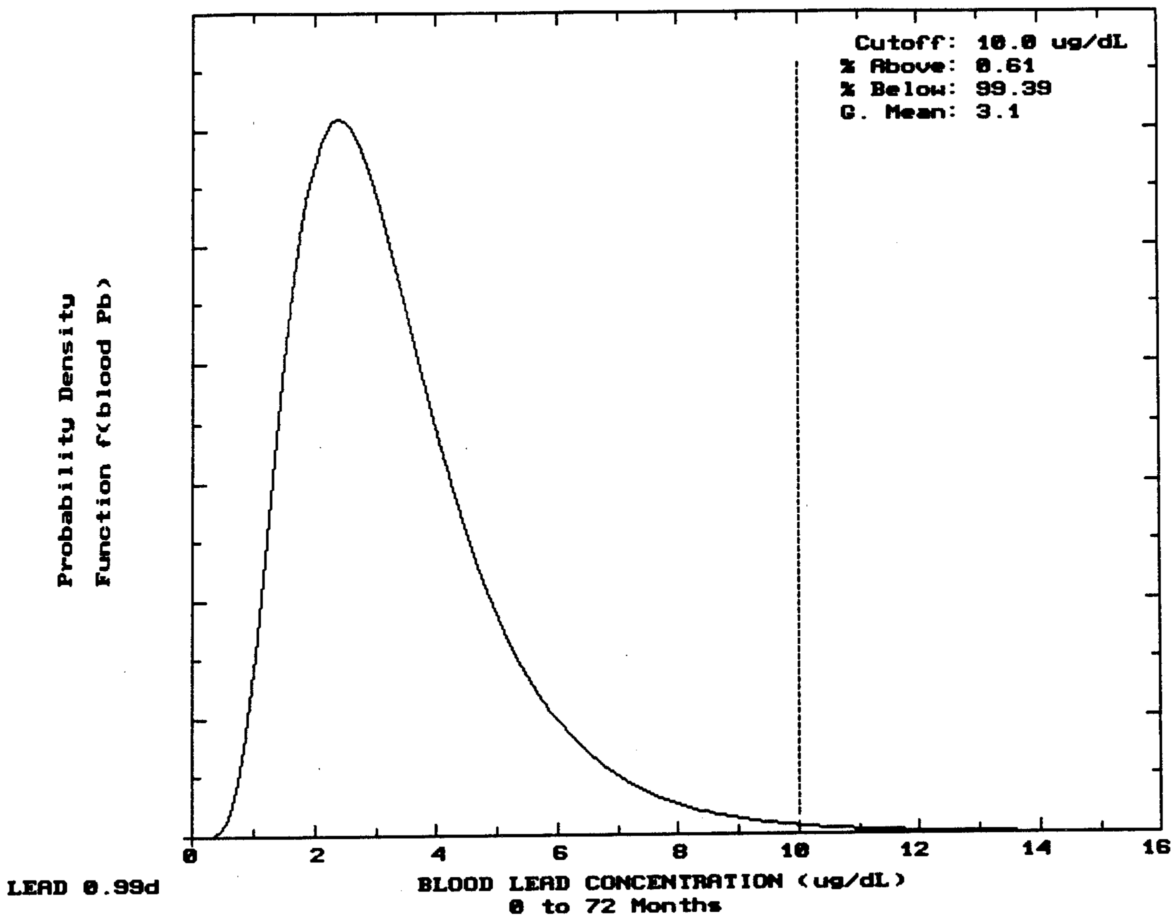

Figure H-1. Estimated Distribution of Blood Lead Concentrations in Resident Children at the POL Tank Farm

Table H-68
California DTSC Lead Risk Assessment Spreadsheet Model Results for the POL Tank Farm

California DTSC Lead Risk Assessment Spreadsheet Model Version 1.1

Galena AFB Phase 1 Risk Assessment - POL Tank Farm

Input Data Exposure Medium	Level	Receptor Blood Lead Concentrations (ug/dL) By Percentile		50th	90th	95th	98th	99th
LEAD IN AIR (ug/m^3)*	0.018							
LEAD IN SOIL (ug/g)	86	BLOOD Pb, Adult	(ug/dl)	1.6	2.5	2.8	3.3	3.6
LEAD IN WATER (ug/l)	11	BLOOD Pb, Child	(ug/dl)	3.2	5.0	5.6	6.5	7.2
PLANT UPTAKE? 1=YES 0=NO	0	BLOOD Pb, Child (pica)	(ug/dl)	7.6	11.9	13.5	15.6	17.2
AIRBORNE DUST (ug/m^3)*	50							

EQUATIONS (BY PATHWAY AND RECEPTOR)

	Blood Pb (ug/dL)	=	Route-specific Constant		Medium Concentration		X	Contact Rate		percen of total
ADULTS										
SOIL CONTACT:	0.02	=	1E-04	g/dl)/(ug/day) *	86	ug/g *		1.85	g soil/day (5 g/m^2 * 0.37 m^2)	1%
SOIL INGESTION:	0.04	=	0.018	g/dl)/(ug/day) *	86	ug/g *		0.025	g soil/day	2%
INHALATION:	0.04	=	1.64	g/dl)/(ug/m^3) *	0.02	ug/m^3				2%
WATER INGESTION:	0.62	=	0.04	g/dl)/(ug/day) *	11	ug/l *		1.4	l water/day	39%
FOOD INGESTION:	0.88	=	0.04	g/dl)/(ug/day) *	10.0	ug Pb/kg diet *		2.2	kg diet/day	55%
CHILDREN (TYPICAL)										
SOIL CONTACT:	0.01	=	1E-04	g/dl)/(ug/day) *	86	ug/g *		1.4	g soil/day (5 g/m^2 * 0.28 m^2)	0%
SOIL INGESTION:	0.33	=	0.0704	g/dl)/(ug/day) *	86	ug/g *		0.06	g soil/day	10%
INHALATION:	0.04	=	1.92	g/dl)/(ug/m^3) *	0.02	ug/m^3				1%
WATER INGESTION:	0.70	=	0.16	g/dl)/(ug/day) *	11	ug/l *		0.4	l water/day	22%
FOOD INGESTION:	2.08	=	0.16	g/dl)/(ug/day) *	10.0	ug Pb/kg diet *		1.3	kg diet/day	66%
CHILDREN (PICA)										
SOIL CONTACT:	0.01	=	1E-04	g/dl)/(ug/day) *	86	ug/g *		1.4	g soil/day (5 g/m^2 * 0.25 m^2)	0%
SOIL INGESTION:	4.76	=	0.0704	g/dl)/(ug/day) *	86	ug/g *		0.79	g soil/day	63%
INHALATION:	0.04	=	1.92	g/dl)/(ug/m^3) *	0.02	ug/m^3				1%
WATER INGESTION:	0.70	=	0.16	g/dl)/(ug/day) *	11	ug/l *		0.4	l water/day	9%
FOOD INGESTION:	2.08	=	0.16	g/dl)/(ug/day) *	10.0	ug Pb/kg diet *		1.3	kg diet/day	27%

* = Default value per DTSC

EQUATIONS, DIETARY LEAD

TOTAL DIETARY LEAD	0.945 * 10 + 0.055 * Pb in produce (ug/kg) =	10.0	ug/kg
LEAD IN PRODUCE	= 10 ug/kg or 0.00045 * soil lead =	10.0	ug/kg

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LEAD MODEL Version 0.99d

AIR CONCENTRATION: 0.100 ug Pb/m3 DEFAULT
Indoor AIR Pb Conc: 30.0 percent of outdoor.
Other AIR Parameters:

Age	Time Outdoors (hr)	Vent. Rate (m3/day)	Lung Abs. (%)
0-1	1.0	2.0	32.0
1-2	2.0	3.0	32.0
2-3	3.0	5.0	32.0
3-4	4.0	5.0	32.0
4-5	4.0	5.0	32.0
5-6	4.0	7.0	32.0
6-7	4.0	7.0	32.0

DIET: DEFAULT

DRINKING WATER Conc: 19.00 ug Pb/L
WATER Consumption: DEFAULT

SOIL & DUST:
Soil: constant conc.
Dust: constant conc.

Age	Soil (ug Pb/g)	House Dust (ug Pb/g)
0-1	330.0	330.0
1-2	330.0	330.0
2-3	330.0	330.0
3-4	330.0	330.0
4-5	330.0	330.0
5-6	330.0	330.0
6-7	330.0	330.0

Additional Dust Sources: None DEFAULT

PAINT Intake: 0.00 ug Pb/day DEFAULT

MATERNAL CONTRIBUTION: Infant Model
Maternal Blood Conc: 2.50 ug Pb/dL

CALCULATED BLOOD Pb and Pb UPTAKES:

YEAR	Blood Level (ug/dL)	Total Uptake (ug/day)	Soil+Dust Uptake (ug/day)
0.5-1:	6.1	11.48	7.37
1-2:	7.3	17.93	11.39
2-3:	6.9	18.77	11.60
3-4:	6.6	19.10	11.82
4-5:	5.8	16.61	9.03
5-6:	5.1	16.34	8.23
6-7:	4.7	16.38	7.82

YEAR	Diet Uptake (ug/day)	Water Uptake (ug/day)	Paint Uptake (ug/day)	Air Uptake (ug/day)
0.5-1:	2.42	1.66	0.00	0.02
1-2:	2.46	4.05	0.00	0.03
2-3:	2.82	4.29	0.00	0.06
3-4:	2.76	4.45	0.00	0.07
4-5:	2.74	4.77	0.00	0.07
5-6:	2.93	5.09	0.00	0.09
6-7:	3.25	5.21	0.00	0.09

Table H-69
IEUBK Model Parameters for Estimating Blood Lead Concentrations in Resident Children at the West Unit

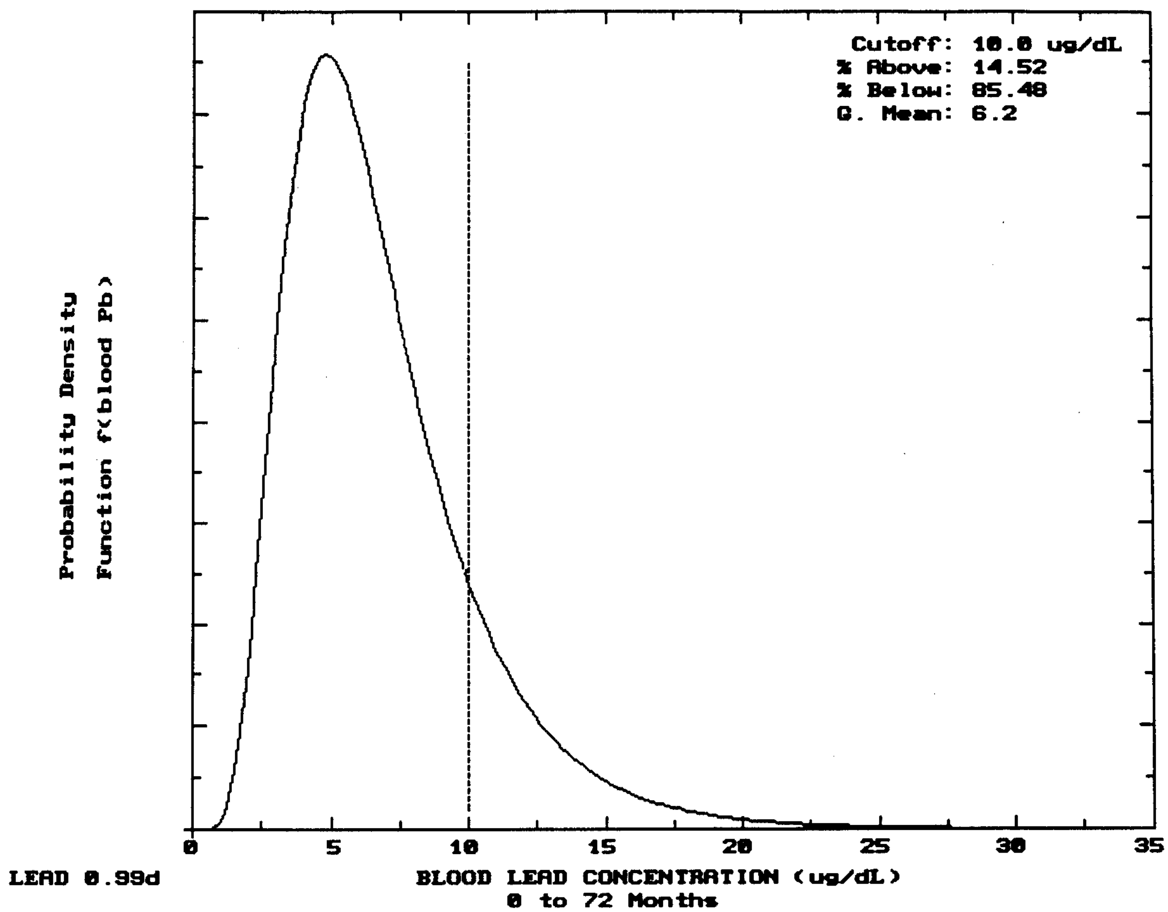

Figure H-2. Estimated Distribution of Blood Lead Concentrations in Resident Children at the West Unit

Table H-70
California DTSC Lead Risk Assessment Spreadsheet
Model Results for the West Unit

California DTSC Lead Risk Assessment Spreadsheet Model Version 1.1

Galena AFB Phase 1 Risk Assessment - West Unit

Input Data Exposure Medium	Level	Receptor Blood Lead Concentrations (ug/dL) By Percentile		50th	90th	95th	98th	99th
LEAD IN AIR (ug/m^3)*	0.018							
LEAD IN SOIL (ug/g)	330	BLOOD Pb, Adult	(ug/dl)	2.2	3.5	3.9	4.5	5.0
LEAD IN WATER (ug/l)	19	BLOOD Pb, Child	(ug/dl)	4.7	7.4	8.3	9.6	10.6
PLANT UPTAKE? 1=YES 0=NO	0	BLOOD Pb, Child (pica)	(ug/dl)	21.7	34.0	38.5	44.5	49.0
AIRBORNE DUST (ug/m^3)*	50							

EQUATIONS (BY PATHWAY AND RECEPTOR)

	Blood Pb (ug/dL)	=	Route-specific Constant		Medium Concentration		X	Contact Rate	percen of total
ADULTS									
SOIL CONTACT:	0.06	=	1E-04	g/dl)/(ug/day) *	330	ug/g *	1.85	g soil/day (5 g/m^2 * 0.37 m^2)	3%
SOIL INGESTION:	0.15	=	0.018	g/dl)/(ug/day) *	330	ug/g *	0.025	g soil/day	7%
INHALATION:	0.06	=	1.64	g/dl)/(ug/m^3) *	0.03	ug/m^3			3%
WATER INGESTION:	1.06	=	0.04	g/dl)/(ug/day) *	19	ug/l *	1.4	l water/day	48%
FOOD INGESTION:	0.88	=	0.04	g/dl)/(ug/day) *	10.0	ug Pb/kg diet *	2.2	kg diet/day	40%
CHILDREN (TYPICAL)									
SOIL CONTACT:	0.05	=	1E-04	g/dl)/(ug/day) *	330	ug/g *	1.4	g soil/day (5 g/m^2 * 0.28 m^2)	1%
SOIL INGESTION:	1.28	=	0.0704	g/dl)/(ug/day) *	330	ug/g *	0.06	g soil/day	27%
INHALATION:	0.07	=	1.92	g/dl)/(ug/m^3) *	0.03	ug/m^3			1%
WATER INGESTION:	1.22	=	0.16	g/dl)/(ug/day) *	19	ug/l *	0.4	l water/day	26%
FOOD INGESTION:	2.08	=	0.16	g/dl)/(ug/day) *	10.0	ug Pb/kg diet *	1.3	kg diet/day	44%
CHILDREN (PICA)									
SOIL CONTACT:	0.05	=	1E-04	g/dl)/(ug/day) *	330	ug/g *	1.4	g soil/day (5 g/m^2 * 0.25 m^2)	0%
SOIL INGESTION:	18.25	=	0.0704	g/dl)/(ug/day) *	330	ug/g *	0.79	g soil/day	84%
INHALATION:	0.07	=	1.92	g/dl)/(ug/m^3) *	0.03	ug/m^3			0%
WATER INGESTION:	1.22	=	0.16	g/dl)/(ug/day) *	19	ug/l *	0.4	l water/day	6%
FOOD INGESTION:	2.08	=	0.16	g/dl)/(ug/day) *	10.0	ug Pb/kg diet *	1.3	kg diet/day	10%

EQUATIONS, DIETARY LEAD

TOTAL DIETARY LEAD 0.945 * 10 + 0.055 * Pb in produce (ug/kg) = 10.0 ug/kg

LEAD IN PRODUCE = 10 ug/kg or 0.00045 * soil lead = 10.0 ug/kg

* = Default value per DTSC

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APPENDIX I

Ecological Assessment Exposure Parameters

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I.1 INTRODUCTION

Constants used in the exposure assessment for the ERA are listed below. Assessment endpoint species contaminant intake is detailed in Section 3.2.3. Spreadsheets showing the calculations are shown in Appendix K. The size of the sites are shown in Table I-1. The areas were also used in the intake estimation. Areas are based on the extent of soil contamination. The "Time on Site" factor accounts for migration of assessment endpoint species out of the study area.

I.1.1 Meadow Vole

The values used to calculate meadow vole exposure are:

- Body weight: 0.039 kilograms (EPA, 1993);
- Water intake: 0.0053 Liters per day (calculated using methodology in Section 3.2.3);
- Food ingestion rate: 0.0049 kilograms dry matter per day (calculated using methodology in Section 3.2.3);
- Percent of food from contaminated source: 100%;
- Fraction of food in diet: 0.97;
- Fraction of soil in diet: 0.024 (Beyer et al., 1993);
- Home range: 0.034 acres (EPA, 1993); and
- Time on site: 1 (all year).

I.1.2 Spotted Sandpiper

The values used to calculate spotted sandpiper intake are:

Table I-1
Site Areas

Site or Source Area	Acres
FPTA	1.58
POL Tank Farm	6.39
Bldg. 1845	0.24
JP4-Fillstands	1.33
Power Plant UST No. 49	0.03
Million Gallon Hill	6.26
Waste Accumulation Area	0.81

- Body Weight: 0.047 kilograms (EPA, 1993);
- Water intake: 0.67 Liters per day (calculated using methodology in Section 3.2.3);
- Food ingestion rate for seabirds: 0.00744 kilograms dry matter per day (calculated using methodology in Section 3.2.3);
- Fraction of food in diet: 0.82;
- Fraction of soil in diet: 0.18 (value for western sandpiper, Beyer et al, 1994);
- Home range: 2.5 acres (CDFG, 1990); and
- Time on site: 5 months (May - September, Robbins, 1983).

I.1.3 Red Fox

The values used to calculate red fox intake are:

- Body weight: 5.25 kg (male, EPA, 1993);
- Water intake: 0.44 Liters/day (calculated using methodology in Section 3.2.3);
- Food ingestion rate: 0.268 kilograms dry matter/day (calculated using methodology in Section 3.2.3);
- Percent of food from contaminated source: 100%;
- Fraction of food in diet: 0.97;
- Fraction of soil in diet: 0.028 (Beyer et al., 1993);
- Home range: 1771 acres (EPA, 1993); and
- Time on site: 1 (all year).

I.1.4 Robin

The values used to calculate robin intake are:

- Body weight: 0.077 kilograms (Dunning, 1993);
- Water intake: 0.0105 Liters/day (calculated using methodology in Section 3.2.3);
- Food ingestion rate: 0.01597 kilograms dry matter/day (calculated using methodology in Section 3.2.3);]
- Percent of food from contaminated source: 100%;
- Fraction of food in diet: 0.896;
- Fraction of soil in diet: 0.104 (Woodcock, Beyer et al., 1993);
- Home range: 2.00 acres (foraging home range - fledglings, EPA, 1993); and
- Time on site: 6 months.

I.1.5 American Kestrel

The values used to calculate American kestrel intake are:

- Body weight: 0.120 kilograms (female, Dunning, 1993);
- Water intake: 0.014 Liters/day (calculated using methodology in Section 3.2.3);
- Food ingestion rate: 0.01096 kilograms dry matter/day (calculated using methodology in Section 3.2.3);
- Percent of food from contaminated source: 100%;
- Fraction of food in diet: 0.90;
- Fraction of soil in diet: 0.10;

- Home range: 499 acres (EPA,1993); and
- Time on site: 6 months.

I.1.6 Savannah Sparrow

The values used to calculate Savannah sparrow intake are:

- Body weight: 0.0206 kilograms (male, Dunning, 1993);
- Water intake: 0.004 Liters/day (calculated using methodology in Section 3.2.3);
- Food ingestion rate: 0.00521 kilograms dry matter/day (calculated using methodology in Section 3.2.3);
- Percent of food from contaminated source: 100%;
- Fraction of food in diet: 0.89;
- Fraction of soil in diet: 0.104 (woodcock, Beyer et al., 1994);
- Home range: 2.00 acres (value used for robin, EPA, 1993).; and
- Time on site: 6 months.

I.1.7 Northern Pike

Northern Pike intake was not assessed, therefore no intake parameters are listed.

I.1.8 Invertebrates (Aquatic and Terrestrial)

Invertebrate intake was not assessed, therefore no intake parameters are listed.

I.2 REFERENCES

Beyer, W.N., Connor, E.E., and S. Gerould. "Estimates of Soil Ingestion by Wildlife." *Journal of Wildlife Management* 58(2): 375-382, 1994.

U.S. Environmental Protection Agency (EPA) *Wildlife Exposure Factors Handbook.* EPA/600/R-93/187a, 1993.

California Department of Fish and Game (CDFG), *California's Wildlife*, Volume 2. California Statewide Wildlife Habitat Relationship System, 1990.

Dunning, J.B. (Editor) *CRC Handbook of Avian Body Masses.* CRC Press. Boca Raton, Fl. 1993.

APPENDIX J

Ecological Assessment Toxicity Profiles

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Table J-1
Ecological Toxicity Profile for 1,1-Dichloroethane

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
1,1-Dichloroethane						
Bluegill (*Lepomis macrochirus*)	Static test		96 hour	Death	LC_{50} = 550 ppm	1
Silverside (*Meidia beryllina*)	Static test		96 hour	Death	LC_{50} = 480 ppm	1
Guppy (*Poecilia reticulata*)			7 days	Death	LC_{50} = 202 ppm	1
Rat				Death	LD_{50} = 725 mg/kg/day	2

1,1-Dichloroethane is a man-made liquid used in the production of 1,1,1-trichloroethane and other chemicals. It usually exists in the vapor phase after release into the environment during industrial processes, or when formed as a byproduct of 1,1,1-trichloroethane degradation. 1,1-Dichloroethane is degraded by photolysis. The potential for 1,1-dichloroethane to bioconcentrate in aquatic organisms is low.

Estimated Bioconcentration Factor (BCF) = 6.6

Environmental Fate:
- Vapor pressure at 20°C = 182 mmHg
- Henry's law constant = 4.2×10^{-2} atm m^3/mol at 20-25°C
- Log K_{ow} = 1.79
- Log K_{oc} = 1.76

References:

1. Hazardous Substances Data Base (HSDB), 1994, On-Line Computer Database: U.S. Department of Health and Human Services, Bethesda, MD.

2. Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological Profile for 1,1-Dichloroethane, 1990.

Table J-2
Ecological Toxicity Profile for 1,1-Dichoroethene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
1,1-Dichloroethene						
Mouse		Inhalation	7 days, 22-23 hrs/day	Death (70% mortality)	LOAEL= 40 ppm	1
Rat		Inhalation	10 days, gestation days (6-15), 7 hrs/day	Skeletal alteration	LOAEL = 80 ppm	1
Rabbit		Inhalation	13 days, (gestation days 6-18), 7 hrs/day	Fetal anomalies and resorptions	LOAEL = 160 ppm	1
Mouse		Inhalation	1 day 4 hrs/day	Edema of lungs	LOAEL = 76 ppm	1
Monkey		Inhalation	90 days 24 hrs/day	Death (66% mortality)	LOAEL 25 ppm	1
Mouse (Female)		Oral-gavage	1 day, 1 time	Death	LD_{50} = 194 mg/kg/day	1
Rat		Oral-gavage	1 day	Death	LD_{50} = 1,550 mg/kg/day	1
Cat		Inhalation	13 weeks 6 hrs/day 5 days/week	Enzyme changes, histopathology, decreased body weight	LOAEL - 1,000 ppm	1
Freshwater organisms		Medium	Acute	Proposed Water Quality Criteria-protective of aquatic life	LOEL = 11600 µg/L	2

Table J-2
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
1,1-Dichloroethene						
Rat		Inhalation	7 hrs/day Gd 6-15	Retarded fetal development	LOAEL = 6,000 ppm	1
Mouse		Oral-gavage	78 weeks 5 days/week 1 ×/day	Cancer Effect Level - uterus	LOAEL = 3,331 mg/kg/day	1
Green algae (*Selenastrum capricornutum*)			96 hours	Inhibition of chlorophyll synthesis	EC_{50} > 798 mg/L	3
Bluegill (*Lepomis macrochirus*)		Medium-static	96 hours	Death	LC_{50} = 220 ppm	3
Meadow Vole					NOAEL = 59.47 mg/kg/day	4
Red Fox					NOAEL = 3.25 mg/kg/day	4

The primary sources of 1,1-dichloroethene in the environment are related to the synthesis, fabrication, and transport of 1,1-dichloroethene and the fabrication of its polymer products. Most of the 1,1-dichloroethene released into the environment will partition into the atmosphere. Based on the K_{ow}, bioconcentration of the compound by terrestrial or aquatic organisms is not expected (1).

Bioconcentration Factor (BCF) = 2.5

Environmental Fate:
- Vapor pressure at 20°C = 500 mmHg
- Henry's law constant = 0.19 atm m^3/mol at 20-25°C
- Log K_{ow} = 1.32
- Log K_{oc} = 1.81

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR), Toxicological Profile for 1,1-Dichloroethene, 1994.
2. U.S. Environmental Protection Agency (EPA), 1991, Water Quality Criteria Summary: Office of Science and Technology, Health and Ecological Criteria Division, Washington, D.C.
3. Hazardous Substances Data Base (HSDB), 1994, On-Line Computer Database: U.S. Department of Health and Human Services, Bethesda, MD.
4. Screening Benchmarks for Ecological Risk Assessment, Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge, TN, 1994.

Table J-3
Ecological Toxicity Profile for 1,1,1-Trichloroethane

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
1,1,1-Trichloroethane						
Rat		Inhalation	30 minutes	Death	LC_{50}=22,241 ppm	1
Mouse		Inhalation	60 minutes	Death	LC_{50}=18,358 ppm	1
Rabbit		Inhalation	90 days 24 hours/day	Body weight gain reduced by 66%	LOAEL=380 ppm	1
Guinea pig		Inhalation	45 days 5 days/week 7 hours/day	Degeneration in testes	LOAEL=5,000 ppm	1
Rabbit		Oral - gavage	1 day	Death	LD_{50}=5,660 mg/kg/day	1
Mouse		Oral - gavage	1 day	Death	LD_{50} = 11,240 mg/kg/day	1
Rat		Oral - gavage, oil	78 weeks 5 days/week	Survival decreased ≈ 50%	LOAEL=750 mg/kg/day	1
Rabbit		Dermal	24 hours	Death	LOAEL=15,800 mg/kg/day	1
Saltwater aquatic organisms			Acute	Proposed AWQC - protection of aquatic life	LOEL=31.2 mg/L	2
Meadow vole					NOAEL=927.3 mg/kg/day	3
Red fox					NOAEL=201.4 mg/kg/day	3

1,1,1-Trichloroethane was developed as a safer solvent to replace other chlorinated solvents. The compound is used as a solvent for adhesives and in metal processing, aerosols, lubricants, drain cleaners, shoe polishes, and printing inks. The dominant environmental fate process for this compound is volatilization to the atmoshpere. In soil, the compound displays high mobility and potential for leaching into groundwater. An experimental BCF of 9 in bluegill sunfish has been determined for this chemical, suggesting that in fish and other aquatic organisms, uptake from water should not be an important fate process. This compound is not expected to biomagnify in the food chain (1).

Environmental Fate:
- Log K_{ow} = 2.49
- Log K_{oc} = 2.03
- Vapor pressure at 20°C = 124 mm Hg
- Henry's Law constant at 20°C = 6.3×10^{-3} atm m^3/moL

References:
1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for 1,1,1-Trichloroethane. 1993.
2. EPA. Water Quality Criteria Summary. Office of Science and Technology, Health and Ecological Criteria Division. Washington. D.C., 1992
3. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences and Health Sciences Research Division. Oak Ridge National Labs. Oak Ridge, TN. 1994.

Table J-4
Ecological Toxicity Profile for 1,1,2-Trichloroethane

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
1,1,2-Trichloroethane						
Rat		Inhalation	6 hours	Death	LC_{50} = 1,654 ppm	1
Mouse		Inhalation	6 hours	Death	LC_{50} = 416 ppm	1
Rat		Oral-gavage	1 time	Death	LD_{50} = 839 mg/kg/day	1
Mouse		Oral-gavage	1 time	Death	LD_{50} = 378 mg/kg/day	1
Mouse		Oral-gavage	78 weeks 5 days/week	Increased Mortality	LOAEL = 195 mg/kg/day	1
Rabbit		Dermal	1 time	Death	LD_{50} = 3.73 mL/kg	1
Freshwater aquatic organisms			Chronic	Proposed AWQC - protection of aquatic life	LOEL = 9.4 mg/L	2
Fathead minnow (*Pimephales promelas*)		Medium, flow-through	96 hours	Death	LC_{50} = 81.6 mg/L	3

Environmental Fate:
- Log K_{ow} = 2.42
- Log K_{oc} = 1.06 - 2.49 (estimated)
- Vapor Pressure at 25°C = 22.49 mmHg
- Henry's Law Constant at 25°C = 9.1×10^{-4} atm m^3/mol (1)

Bioconcentration Factor (BCF):
- Fish = 17 (1)

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for 1,1,2-Trichloroethane, 1989.
2. EPA. Water Quality Criteria Summary. Office of Sciences and Technology, Helath and Ecological Criteria, Wahsington, D.C. 1991.
3. Hazardous Substance Data Base 9HSDB), On-line Computer Database. U.S. Department of Health and Human Services, Bethesda, MD. 1995.

Table J-5
Ecological Toxicity Profile for 1,1,2,2-Tetrachloroethane

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
1,1,2,2-Tetrachloroethane						
Rat		Oral -gavage	27 weeks	Less serious effects on testes	LOAEL = 3.2 mg/kg/day	1
Mouse	142 mg/kg/day	Oral - gavage	78 weeks 5 days/week	Liver cancer	Cancer effect level	1
Freshwater aquatic organism			Chronic	Prosposed AWQC; Protection of aquatic life	LOEL = 2,400 mg/L	2
Guinea Pig		Inhalation	30 minutes	Narcosis	LOAEL = 5,050 ppm	1
Rat		Inhalation	30 minutes	Death	LOAEL = 5,050 ppm	1
Water flea (*Daphnia magna*)		Medium	28 days	Reproductive impairment	EC_{50} = 14 mg/L	4
Bluegill (*Lepomis macrochirus*)		Medium - static	96 hours	Death	LC_{50} =21.3 mg/L	4
Alga (*Skeletonema costatum*)			96 hours	Death	LC_{50} = 6.23 - 6.44 mg/L	4

The only major use for 1,1,2,2-Tetralchloroethane is as a feedstock in the production of chorinated ethenes. It may be used as a solvent in cleaning and degreasing metals, in paint removers, varnishes, lacquers, photograhpic films, and as an extractant for oils and fats. It was once an ingredient in insect repellent, fumigants, and weedkillers. Based on a Henry's Law constant of 4.7E-04 atm-m^3/moL, volatilization is a major route of removal from surface water and soil. The K_{oc} of 1.6 suggests that this compound will not adsorb to soil or sediments. A BCF in bluegill sunfish was measured in a 14-day experiment. Based on a K_{ow} of 2.39, BCF factors range from 21-36. There is little indication that 1,1,2,2-Tetrachloroethane will accumulate in aquatic organisms (1).

Bioconcentration:
• BCF = 21- 36

Environmental Fate:
- Log K_{ow} = 2.39
- Log K_{oc} = 1.66
- Vapor pressure at 25°C = 5.95 mmHg
- Henry's Law constant at = 4.7×10^{-4} atm m^3/moL

References:
1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for 1,1,2,2-Tetrachloroethane, 1989.
2. EPA Water Quality Criteria Summary. Office of Science and Technology, Health and Ecological Criteria Division. Washington, D.C., Federal Register Notice 57FR60912. 1991.
3. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences & Health Sciences Research Division. Oak Ridge National Labs. Oak Ridge, TN. 1994.
4. Hazardous Substance Data Base (HSDB). On-line Computer Database. U.S. Department of Health and Human Services, Bethesda, MD. 1995.

Table J-6
Ecological Toxicity Profile for 1,2-Dichlorobenzene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
1,2-Dichlorobenzene						
Guinea pig		Oral	1 time	Death	$LD_{50=}$ 0.8-2.0 ug/kg	1
Mouse		Inhalation	6 hours	Death	LC_{50} = 7,825 mg/m^3	1
Freshwater aquatic organisms			Chronic	Proposed AWQC - protection of aquatic life	LOEL = 763 μg/L	2

The major use of 1,2-Dichlorobenzene is as an intermediate in the synthesis of organic compounds and herbicides. It is used as an industrial solvent, degreaser, and heat-exchange medium (2).

References:
1. Hazardous Substances Data Bank (HSDB). Bethesda, MD, U.S. Department of Health and Human Services, National Library of Medicine, TOXNET files, December 1994.
2. ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices, 5th ed. Cinn. OH, 1988.
3. EPA. Water Quality Criteria Summary. Office of Science and Technology, Health and Ecological Criteria Division, Washington D.D. 1991.

Table J-7
Ecological Toxicity Profile for 1,2-Dichloroethane

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
1,2 Dichloroethane						
Guinea pig		Inhalation	25 weeks 5 days/week 7 hours/day	Death (5/14)	LOAEL = 200 ppm	1
Rabbit		Inhalation	20 weeks 5 days/week 7 hours/day	Death (5/5)	LOAEL = 400 ppm	1
Dog		Inhalation	9 weeks 5 days/week 7 hours/day	Death (2/6)	LOAEL = 1000 ppm	1
Monkey		Inhalation	8 weeks 5 days/week 7 hours/day	Death (2/2)	LOAEL = 1000 ppm	1
Rat	4.7 ppm	Inhalation	4 months prior to mating, continuing through pregnancy	Embryo mortality		1
Rat	14 ppm	Inhalation	6 months	Decreased fertility		1
Rat	50 ppm	Inhalation	Intermittent 2 years	Increased testicular lesions		1
Rat		Water	13 weeks	Decreased body weight gain	LOAEL = 259 mg/kg/day	1
Rat		Oral-gavage	78 weeks	Death (42 out of 50)	LOAEL = 92 mg/kg/day	1
Rat		Oral-gavage	78 weeks	Cancer Effect Level-liver, spleen, adrenal gland, pancreas	LOAEL = 47 mg/kg/day	1

Table J-7
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
1,2 Dichloroethane						
Freshwater aquatic organism			Chronic	Proposed AWQC - protection of aquatic life	LOEL = 20,000 ug/L	3
Meadow Vole					NOAEL = 46.3 mg/kg/day	4
Red Fox					NOAEL = 10.06 mg/kg/day	4
American Robin					NOAEL = 46.81 mg/kg/day	4
Cooper's Hawk					NOAEL = 26.4 mg/kg/day	4
Red-tailed Hawk					NOAEL = 19.3 mg/kg/day	4

1,2-Dichloroethane does not occur naturally. It is produced commercially and used as a chemical intermediate in the production of several other chemicals as well as a lead scavenger additive to unleaded gasoline. Previously it was used in varnish and finish removers, soaps and scouring compounds, solvents, degreasers, paints, adhesives, and fumigants. Releases to surface water and soils are likely to partition rapidly to the atmosphere by volitilization. Little absorption to soil is expected. An experimental BCF of 2 indicates that the compound will not bioconcentrate in aquatic organisms or bioaccumulate in the food chain (1).

Bioconcentration :
- BCF (Bluegill) = 2 (2).

Environmental Fate:
- Log K_{ow} = 1.45 - 1.48
- Vapor Pressure at 20°C = 64 mmHg

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for 1,2-Dichloroethane. 1994.
2. EPA Health Effects Assessement for 1,2-Dichloroethane. 1984.
3. EPA Water Quality Criteria Summary Office of Science and Technology, Health and Ecological Criteria Division, Washington, D.C. 1991.
4. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences and Health Sciences Research Division Oak Ridge National Labs, Oak Ridge,TN. 1994.

Table J-8
Ecological Toxicity Profile for1,2-Dichloroethene(cis-,trans-)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
1,2-Dichloroethene (cis-, trans-)						
Mouse		Inhalation as trans	1 day, 6hrs/day	Death	LC_{50} = 21723 ppm	1
Rat		Oral - gavage as trans	1 day	Death	LC_{50}=1275 mg/kg/day	1
Mouse		Oral - gavage as trans	1 day	Death	LC_{50} = 2122 mg/kg/day	1
Freshwater Aquatic Organsisms		Medium	Acute	Proposed water quality criteria-protective of aquiatic life	LOEL = 11,600 µg/L	2
Bluegill (*Lepomis macrochirus*)		Medium-static	96 hours	Death	LC_{50} = 140 mg/L	3
Meadow Vole					NOAEL = 39.8 mg/kg/day	4
Red Fox					NOAEL = 8.65 mg/kg/day	4

cis- and trans-1,2-Dichloroethene are man-made compounds. Sources of 1,2-dichloroethene environmental exposure include: process and fugitive emissions from its production and use as a chemcial intermediate; evaporation from wastewater streams, landfills, solvents, emissions from combustion or heating of vinyl copolymers. Most of the 1,2-dichloroethene released in the environment will eventually enter the atmosphere or groundwater, where it is broken down further. Bioconcentration factors (BCFs) in fish ranging between 5 and 23 have been estimated for the 1,2-dichloroethene isomers using linear regression. These BCFs suggest that these compounds do not bioconcentrate significantly in aquatic organisms and there is little potential for biomaginfication within the food chain.

cis-1,2-dichloroethene (CAS # 156-59-2):
- Log K_{oc} = 1.51-1.69
- Log K_{ow} = 1.86
- Vapor pressure = 215 mmHg
- Henry's law constant = 4.08 x 10^{-3} atm-m^3/mole at 24.8°C
- Bioconcentration Factor (BCF) = 0.8 (2)

trans-1,2-dichloroethene:
- Log K_{oc} = 1.51-1.69
- Log K_{ow} = 2.09
- Vapor pressure = 336 mmHg
- Henry's law constant = 9.38 x 10^{-3} atm-m^3/mole at 24.8°C

References:

1. Agency for Toxic Substance and Disease Registry (ATSDR) Toxicological Profile for 1,2-Dichloroethene. 1989.
2. Screening Benchmarks for Ecological Risk Assessment, Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge, TN, 1994.
3. Aquatic Information Retrieval (AQUIRE), 1994, On-Line Computer Database: Chemical Information Systems, Inc., Baltimore, Md.
4. Hazardous Substances Data Base (HSDB), 1994, On-Line Computer Database: U.S. Department of Health and Human Services, Bethesda, MD.

Table J-9
Ecological Toxicity Profile for 2-Butanone(MEK)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
2-Butanone (MEK)						
Rat		Inhalation	1 day for 4 hrs	Death	LC_{50} = 11,700 ppm	1
Guinea pig		Inhalation	1 day, 13.5 hrs/day	Death	LOAEL = 33,000 ppm	1
Mouse		Inhalation	10 days, GD 6-15, 7 hr/day	Decreased fetal body weight	LOAEL = 3,000 ppm	1
Rat		Inhalation	7 weeks 7 day/week 7 hrs/day	Death (515)	LOAEL = 6,000 ppm	1
Rat		Gavage	1 day	Death	LD_{50} = 2,737 mg/kg/day	1
Rat	7,700 ppm	Gavage	1 day	Tubular necrosis	LOAEL = 1,080 mg/kg/day	1
Fathead minnow		Medium	96 hours	Death	LC_{50} = 3220 mg/L	2
Bluegill (*Lepomis macrochirus*)		Medium - Static test	48 hours	Death	LC_{50} = 5640 mg/L	3
Mosquitofish (*Gambusia affinis*)		Medium - Static test	96 hours	Death	LC_{50} = 5600 mg/L	3

2-Butanone exhibits outstanding solvent properties, and combined with its low cost, it is often the choice solvent for various industries such as adhesives, magnetic tapes, and printing inks as well as degreasing of metals. 2-Butanone is expected to rapidly volatilize from surface water and soils to the atmosphere. In soil, the compound is expected to display high mobility and does not significantly adsorb to sediment or suspend organic matter in surface waters. 2-Butanone is not expected to bioconcentrate in aquatic systems (1).

Bioconentration:
- BCF Calc from K_{ow} = 0.98

Environmental Fate:
- Log K_{ow} = 0.29
- Log K_{oc} = 0.55
- Vapor pressure at 25°C = 90.6 mm Hg
- Henry's Law constant at 25°C 5.77×10^{-5} atm-m^3/moL

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for 2-Butanone, 1990.
2. Hazardous Substance Data Base (HSDB) On-line Computer Database: U.S. Department of Health and Human Services, Bethesda, MD. 1995.
3. Aquatic Substances Data Base (AQUIRE). On-line Computer Database: Chemical Information Systems, Inc., Baltimore, MD. 1995.

Table J-10
Ecological Toxicity Profile for 2-Hexanone

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
2-Hexanone						
Hen		Inhalation	90 days; 24 hours/day	Death	LOAEL = 200 ppm	1
Rat		Inhalation	11 weeks; 72 hours/week; 18 hours/day	Decreased testicular weight	LOAEL = 700 ppm	1
Rat		Inhalation	21 GD; 6 hours/day	Decreased pup survival and weight	LOAEL = 2000 ppm	1
Rat		Oral - gavage	90 days; 5 days/week; 1x /day	Paralysis	LOAEL = 660 mg/kg/day	1
Fathead minnow (*Pimephales promelas*)		Medium	96 hours	Death	LC_{50} = 428 mg/L	2

2-Hexanone is not currently manufactured, imported, processed or used for commercial purposes in the U.S. Small amounts are released from wood pulping, coal gasification, and oil-shale processing plants through air emissions and water effluent. Leachate from hazardous waste sites is another possible source. Bioconcentration of 2-hexanone by organisms in water is not expected due to a low log K_{ow} of 1.48 and a bioconcentration factor of 7 estimated using empirical regression. Bioaccumulation is not expected to be significant.

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for 2-Hexanone. October 1990.
2. Hazardous Substance Data Base (HSDB). On-line Computer Database. U.S. Department of Health and Human Services, Bethesda, MD. 1995.

Table J-11
Ecological Toxicity Profile for 2-Methylnaphthalene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
2-Methylnaphthalene						
Rat	5 mg/kg	Oral	Not specified	Lethal	Not specified	1
Rat		Oral	Not specified	Death	LD_{50} = 1,630 mg/kg	2
Mice	400 mg/kg	Intraperitoneal injection	Single dose	Complete exfoliation of bronchiolar epithelium	Not specified	3
Mouse	1,000 mg/kg	Intraperitoneal injection	Single dose	20-40% lethality	Not specified	3
Grass shrimp		Medium	96 hour	Death	LC_{50} = 1100 ug /L	4
Sheepshead minnow		Medium	96 hour	Death	LC_{50} = 2000 ug/L	4
Dungeness Crab		Medium	48 hour	Death	LC_{50} = 5.0 mg/L	5
Dungeness Crab		Medium	96 hour	Death	LC_{50} = 1.3 mg/L	5

2-Methylnapthalene (2-MN) is a polycyclic aromatic hydrocarbon (PAH) that is a component of crude oil and a byproduct of combustion. 2-MN adsorbs strongly to soils and is considered immobile in soils (Log K_{ow} = 3.86, K_{oc} = 8.5E+03). Volatilization and biodegradation are the principle removal mechanisms for 2-MN from soils and surface water. Toxicological data for 2-MN is limited and somewhat contradictory.

Bioconentration Factor (BCF):
- Crustaceans = 967-1625 (dimethylnaphthalenes)

References:

1. Clayton, GD & FE Clayton Patty's Industrial Hygiene and Toxicology: Vol 2A, 2B & 2C.
2. Sax's Dangerous Properties of Industrial Materials, Richard J. Lewis, 8th ed.
3. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Naphthalene and 2-Methylnapthatlene, 1989.
4. Eisler, R. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, Invertebrates: a Synoptic Review. U.S. Fish Wildl. Serv. Biol. Rep. 85(1.11). 81 pp. 1987.
5. Hazardous Substances Data Base (HSDB), On - line Computer Database. U.S. Department of Health and Human Services, Bethesda, MD. 1995.

Table J-12
Ecological Toxicity Profile for 2-Methylphenol (O-Cresol)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
O-Cresol (2-Methylphenol)						
Rat		Gavage- oil	Single Exposure	Death	LD_{50} = 1,350 mg/kg/day	1
Rat		Gavage - oil	GD 6-15	Ataxia, tremors, hypoactivity	LOAEL = 450 mg/kg/day	1
Rabbit		Gavage - oil	GD 6-18	Slight fetotoxicity	LOAEL = 100 mg/kg/day	1
Rat		Gavage - oil	13 weeks, 7 days/week, 1/day	Death	LOAEL = 600 mg/kg/day	1
Ferret		Oral - feed	23 days	None	NOAEL = 400 mg/kg/day	1
Freshwater aquatic organisms			Chronic		LOEL = 150 ug/L	2
Rat		Gavage - oil	13 weeks 7 days/week 1 x/day	Convulsions	LOAEL = 400 mg/kg/day	1
Rabbit		Dermal	1 day 24 hours/day	Death	LD_{50} = 890 mg/kg/day	1
Meadow vole					NOAEL = 606 mg/kg/day	2
Red fox					NOAEL = 131.6 mg/kg/day	2
Freshwater aquatic organisms	methyl-phenols		Chronic	Proposed AWQC - protective of aquatic organisms	LOEL = 150 µg/L	3

Table J-12
(Continued)

Cresol exist in three forms: ortho-cresol (o-cresol), meta-cresol (m-cresol), and para-cresol (p-creosol). These forms are manufactured separately and as mixtures. Cresols are widely distributed natural compounds formed as metabolites of microbial activity and excreted in the urine of mammals. Cresols are also a product of combustion and are natural components of crude oil and coal tar. In general, cresols will degrade in surface waters rapidly. BCFs or 14.1 for o-cresol and 19.9 for m-cresol indicate that the isomers of cresol will not bioconcentrate in aquatic systems. Koc values of 17.5-117 have been determined for the three isomeric cresol (1).

Bioconcentration:
- BCF = calculated 17.78

Environmental Fate:
- Log K_{ow} = 1.95
- Log K_{oc} = 1.03
- Vapor pressure at 25°C = 0.299 mmHg
- Henry's Law constant at 25°C = 1.2×10^{6} atm-m^3/moL,

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Cresols, 1990.
2. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge, TN, 1994.
3. U.S. Environmental Protection Agency (EPA), 1991, Water Quality Criteria Summary: Office of Science and Technology, Health and Ecological Criteria Division, Washington, D.C., May.

Table J-13
Ecological Toxicity Profile for 2,4-Dimethylphenol

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
2,4-Dimethylphenol						
Farhead minnow (*Pimephales promelas*)		Flow-through	96 Hours		LC_{50} = 17 mg/L	1
Water flea (*Daphnia magna*)		Static	48 Hour		LC_{50} = 2.12 mg/L	1
Duckweed (*Lemina minor*)		Static	48 Hour		LC_{50} = 292 mg/L	1

Environmental Fate:
- Log K_{ow} = 2.3 (2)

Bioconcentration Factor (BCF):
- Bluegill, Log BCF = 1.18 (2)

References:

1. Hazardous Substance Data Base (HSDB), On-line Computer Database. U.S. Department of Health and Human Services, Bethesda, MD. 1995.
2. Sims and Hansen, Soil, Transport, and Fate Database, Version 2.0, Utah State University, April 1991.

Table J-14
Ecological Toxicity Profile for 4-Methyl-2-Pentanone (MIBK)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
4-Methyl-2-Pentanone (MIBK)						
Redwinged blackbird		Oral		Death	LD_{50} = 100 mg/kg	1
Goldfish (*Caeassins anratus*)			24 Hours	Death	LC_{50} = 460 mg/L	1
Fathead minnow		Medium - flow-through	96 Hours	Death	LC_{50} = 505 mg/L	1
Meadow vole					NOAEL = 49.56 mg/kg/day	2
Mink					NOAEL = 17.638 mg/kg/day	2
Red fox					NOAEL = 10.76 mg/kg/day	2

Environmental Fate:
- Log K_{ow} = .72 (3)

Bioconcentration Factor (BCF):
- BCF = 2.1 (3)

References:

1. Hazardous Substance Data Base 9HSDB), On-line Computer Database. U.S. Department of Health and Human Services, Bethesda, MD. 1995.
2. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge, TN, 194.
3. Sims and Hansen, Soil, Transport, and Fate Database, Version 2.0, Utah State University, April 1991.

Table J-15
Ecological Toxicity Profile for 4-Methylphenol (p-cresol)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
4-Methylphenol (p-cresol)						
Rat		Oral (gavage)	13 weeks 7 days/week 1x /day	Convulsions, coma, decreased body weight gain	LOAEL =600 mg/kg/day	1
Rat		Oral (gavage)	GD 6-15	Slight fetotoxicity	LOAEL = 450 ppm	1
Rabbit		Dermal	24 hours	Death	LD_{50} = 890 mg/kg/day	1
Ciliate (*Tetrahymena pyriformis*)			24 Hours	Death	LC_{50} = 3.5 mmole/L	2

p-Cresol is used in the formulation of antioxidants and as a photodegradation protectant. It is also widely used in the fragrance and dye industry. K_{oc} values of 17.5-117 have been calculated using regression analysis for all three cresol isomers. The log K_{ow} for p-cresol has been estimated at 1.94 and the log K_{oc} is estimated to be 49. Bioconcentration Factor (BCF) of 13.5 has been estimated for p-cresol.

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Cresols. October 1990.
2. Hazardous Substances Data Base (HSDB), 1994, On-line Computer Database: U.S. Department of Health and Human Services, Bethesda, MD.

Table J-16
Ecological Toxicity Profile for4,4-DDT

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
4,4-DDT						
Mouse		Oral	70 wks	Decreased survival	LOAEL=13 mg/kg/d	6
Rabbit		Oral		Death	LD50=300 mg/kg	7
Dog		Oral	5 days/wk for 14 months	Maternal and fetal death	LOAEL=12 mg/kg	6
Japanese quail	500 ppm 700 ppm	Diet		No eggs hatched No eggs laid		7
Rat		Gavage	One time	Death	LD_{50} = 113 mg/kg/day	1
Mouse		Oil-gavage	One time	Death	LD_{50} = 1466 mg/kg/day	1
Mouse		Oil-gavage	One time	Death	LD_{50} = 810 mg/kg/day	1
Mouse		Oral-food	3-12 weeks	Decreased IgM antibody titer	LOAEL = 13 mg/kg/day	1
Rat		Oral-food	2 generations	Decreased fertility	LOAEL = 0.35 mg/kg/day	1
Rat		Oral-food	36 weeks	Sterility	LOAEL = 7.5 mg/kg/day	1
Mouse		Oral-food	15-30 weeks	Increased liver hepatomas	LOAEL = 32.5 mg/kg/day	1
Mouse		Oral-food	70 weeks	Decreased survival	LOAEL = 13 mg/kg/day	1
Freshwater Aquatic organisms		Medium	chronic	Protection of aquatic life	AWQC = 0.001 μg/L	11
Mallard					LD_{50} = 2,240 mg/kg	12
California quail					LD_{50} = 595 mg/kg	12

Table J-16
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
4,4-DDT						
Japanese quail					LD_{50} = 841 mg/kg	12
Pheasant					LD_{50} =1,334	12
Sandhill crane					LD_{50} > 1,200	12
Rock dove					LD_{50} > 4,000	12
Bullfrog					LD_{50} > 2,000 mg/kg	12
Sheep	250 ppm	Oral	10-16 weeks	Increased hepatic microsomal enzyme activity		2
Meadow vole					NOAEL = 1.58 mg/kg/day	13
Red fox					NOAEL = 0.344 mg/kg/day	13
American robin					NOAEL = 0.00099 mg/kg/day	13
Great blue heron					NOAEL = 0.00032 mg/kg/day	13
Cooper's hawk					NOAEL = 0.00056 mg/kg/day	13
Red-tailed hawk					NOAEL = 0.00041 mg/kg/day	13

Table J-16
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
4,4-DDE						
Rat		Gavage	One time	Death	LD_{50} = 880 mg/kg/day	1
Mouse		Oil-gavage	One time	Death	LD_{50} = 810 mg/kg/day	1
Mouse		Food	78 weeks	Liver carcinomas	19 mg/kg/day	1
Rat		Oral	One time	Death	LD_{50}=880 mg/kg/d	8
Hamster		Gavage	128 weeks	Adrenal tumors	41.5 mg/kg/day	1
Lesser Kestrel		Environmental		Reproductive	NOAEL in eggs=5 ppm	9
American Sparrow Hawk		Diet	Eggs laid in the 2nd experiment year	10% decrease in shell thickness	2-8 ppm in eggs	7
Ringed turtle dove	20-30 mg total	Diet	3 wks, starting 6 wks before pairing	Decrease in various reproductive endpoints such as reproductive performance.		10
Bald Eagle		Trophic	Lifetime	Reduced reproduction	> 5 mg/kg in egg	4
Cooper's Hawk		Trophic	Lifetime	Egg breakage	> 5 mg/kg	4
Bald Eagle		Trophic	Lifetime	Successful reproduction	NOEL = 2 mg/kg in egg	5
Bald Eagle		Trophic	Lifetime	15% eggshell thinning	16 μg/g in egg	6

Table J-16
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
4,4'-DDD						
Rat		Gavage	One time	Death	LD_{50} > 4000 mg/kg/day	1
Rat		Oral		Death	LD_{50}=113 mg/kg	8
Mouse		Oil-gavage	One time	Death	LD_{50} = 1466 mg/kg/day	1
Rabbit		Oral	One time	Death	LD_{50}=1200 mg/kg	1
Dog		Capsule	36-150 days	Adrenal necrosis	50 mg/kg/day	1
Rat		Food	78 days	Thyroid adenomas, carcinomas	85 mg/kg/day	1

Table J-16
(Continued)

DDT was used extensively as a pesticide and for vector control until its ban in the U.S. in 1972. DDT and its primary metabolites, DDE and DDD, are man-made chemicals and are not known to occur naturally in the environment. The p,p'-isomer of DDT is the most prevalent in the environment (85%) with the o,p'-isomer accounting for the remaining 15%. DDT, DDE and DDD bind to soil and sediment as predicted by their organic carbon partition coefficients (K_{oc}) of 2.4×10^5, 4.4×10^6 and 7.7×10^5 for DDT, DDE and DDD respectively. DDT, DDE and DDD are highly lipid soluble with log octanol-water partition coefficients (log K_{ow}) of 6.19, 7.00, and 6.20 respectively. This lipophilic property, combined with an extremely long half-life, has resulted in bioaccumulation. Biomagnification of residues may result in high levels of residues in organisms at the top of the food chain as has been documented with fish-eating birds (3). The steady-state bioconcentration factor in rainbow trout is estimated to be 12,000. A bioaccumulation factor (BAF) for earthworms is estimated to be 5 for DDT, DDE, adn DDD (14). Because of the extensive past use of DDT worldwide and the persistence of DDT and its metabolites, these materials are virtually ubiquitous and are continually being transformed and redistributed in the environment (1).

DDT produces embryotoxicity and fetotoxicity but not teratogenicity in animals. Intermediate oral exposure to DDT in animals has been shown to produce developmental effects such as infertility, mortality, and slow development. The reproductive capability of both males and females is adversely affected by DDT. DDT enhances the metabolism of estrogen. This creates an endocrine imbalance that affects the egg-laying and nesting cycle in birds in such a way that total reproductive success and survival of young during the nesting season may be reduced (3). DDE is far more persistent then DDT or DDD in birds, having a half-life in excess of 200 days. DDE has been significantly correlated with reduced eggshell thickness and brood sizes of ospreys, bald eagles and some species of falcons (4). The severity of effects of DDE (and other persistent organochlorines as well) on various raptor species and populations has been related to their position in food chains. Species feeding on prey low on the food chain, such as herbivorous mammals, or on resident prey unexposed to contamination have not been adversely affected; whereas those feeding on prey higher on the food chain, such as birds associated with aquatic habitats- especially in areas of contamination - often have been severely affected (6). Rat study with simultaneous exposure of DDT (7 ppm), aldrin (5 ppm), endrin (5 ppm) or heptachlor (5 ppm) increased the adverse effects on conception rate and pup survival, but effects appeared less than additive. Carcinogenicity has been shown in some laboratory animals (2).

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for 4,4'-DDT, 4,4'-DDE, and 4,4'-DDDctober, 1992.
2. NIOSH Special Occupational Hazard Review for DDT. U.S. Department of Health, Education and Welfare, 1978.
3. Klaassen, C.D., Amdur, M.O., and J. Doull (Editors) Casarett and Doull's Toxicology, Third Edition, Macmillian Publishing, New York. 1986.
4. Wiemeyer, S.N., "Effects of Environmental Contaminants on Raptors in the Midwest." In: Proc. Raptor Management Symposium and Workshop. Natl. Wildl. Fed., Washington, D.C., pages 168-181, 1991.
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6. Wiemeyer, S.N., Bunck, C.M. and C.J. Stafford "Environmental Contaminants in Bald Eagle Eggs-1980-84-and Further Interpretations of Relationships to Productivity and Shell Thickness" Arch. Environ. Contam. Toxicol. Vol 24, 213-227, 1993.
7. Hazardous Substances Data Bank. Bethesda, MD, U.S. Department of Health and Human Services, National Library of Medicine, TOXNET files. December, 1994.
8. Sax, I. and Lewis, R. J. Sr. Dangerous Properties of Industrial Materials. 7th ed., Vol. II. Von Nostrand Reinhold, New York, 1989.
9. Negro, J. J., Donazar, J. A., Hernandez, L. M., Hernandez, M. A., and Hiraldo, F. "Organochlorine and Heavy Metal Contamination in Non-Viable Eggs and Its Relation to Breeding Success in a Spanish Population of Lesser Kestrels (*Falcan nanmanni*)." Environmental Pollution. 82, 201-205 (1993).
10. Keith, J. O. and Mitchell, C. A. "Effects of DDE and Food Stress on Reproduction and Body Condition of Ringed Turtle Doves." Arch. Environ. Contam Toxicol. 25, 192-203, 1993.
11. U.S. Environmental Protection Agency Quality Criteria for Water Ambient Water Quality Criteria for Protection of Freshwater Aquatic Organisms. May 1991.
12. Hudson, R.H., Tucker, R.K., and M.A. Haegele. Handbook of Toxicity of Pesticides to Wildlife. 2nd Edition. U.S. Department of Interior. Fish and Wildlife Service. Resource Publication 153. Washington, D.D., 1984.
13. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences and Health Sciences Research Division. Oak Ridge National Labs, Oak Ridge, TN. 1994.
14. Beyer, W. N. "Evaluating Soil Contamination" U.S. Fish Wildl. Serv., Biol. Rep., 90 (2), 25pp., 1990.

Table J-17
Ecological Toxicity Profile for Acenaphthene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Acenaphthene						
Rat	2 gm/kg	Oral	32 Days	Decreased body weight, changes in peripheral blood flow, mild damage to kidneys & liver		1
Rat		Oral	Not specified	Death	LD_{50} = 8 gm/kg	5
Mouse		Oral	Not specified	Death	LD_{50} = 5289 mg/kg	6
Guinea pig		Oral	Not specified	Death	LD_{50} = 10 gm/kg	7
Freshwater aquatic organism			Chronic	Proposed AWQC-Protection of aquatic life	LOEL = 520 ug/L	9
Saltwater aquatic organism			Chronic	Proposed AWQC-Protection of aquatic life	LOEL = 710 ug/L	9
Mouse		Oral	Not specified	Pre-implantation mortality, decreased litter size	TD_{LO} = 7200 mg/kg	8
Rat	12 mg/m^3	Inhalation	4 hrs/day 6 days/week 5 months	Toxic effects on blood, lung, glandular constituents		2
Sheephead minnows	> 0.52 < 0.97 mg/l	Medium	28 days post-hatch	Decreased survival, growth & development		3
Rainbow trout		Medium	Acute (48 hr)	Death	LC_{50} = 1130 ug/L	4

Acenapthene is a polycyclic aromatic hydrocarbon (PAH) that is a byproduct of incomplete combustion which adsorbs strongly to suspended particulate and especially particules high in organic content. Acenapthene is considered slightly mobile in soil (Log K_{ow}= 3.92, K_{oc}= 2065 - 3230). Bioconcentration factor in Bluegill was 2.59. Bioaccumulation in vertebrates is considered to be short-term. Biodegration in aerobic soils is estimated to be 10 -102 days.

References:

1. Knobloch K. et al; Med Pracy 20; 210 (1969).
2. Reshetyuk AL. Gig Tr Prof Zabol 14; 4(1970).
3. Ward GS. et al; J Toxicol Environ Health 8(1-2); 225-40 (1981).
4. Holcombe GW. et al; Ecotoxicol Environ 7 (4); 400-9 (1983).
5. Farm Chem Handbook pg 101 (1991).
6. Gig Tr Prof Zabol, vol 17(11) pg 5 (1973).
7. Gig Tr Prof Zabol, vol. 24 (3) pg 25 (1980).
8. Osaka-furitsu Koshu Eisei Kenkyusho Kerkyu Hokoku Shokuhin Eis, vol 8, pg 29 (1977).
9. Federal Ambient Water Quality Criteria. Federal Register Notice 57FR60890.

Table J-18
Ecological Toxicity Profile for Acenaphthylene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Acenaphthylene						
Rat		Intraperitoneal injection	Not specified	Death	LD_{50} = 1,700 mg/kg	1
Carp (*Cyprinus carpio*)		Force fed	90 Hours	Death	EC = 111-116 mg/kg	2
Carp (*Cyprinus carpio*)		Force fed	< 19 Hours	Death	EC = 132 mg/kg	2

Acenaphthylene is a polycyclic aromatic hydrocarbon (PAH) that is a byproduct of incomplete combustion. In the environment, it has low to slight mobility in soils. Biodegradation occurs in aerobic soils with an estimated $t_{1/2}$ of 12 - 121 days. Limited toxicity data is available for acenaphthylene.

Environmental Fate:

- Log K_{ow} = 4.07
- Log K_{oc} = 3.68

Bioconcentration:
- Log BCF 2.11 - 2.76

References:

1. Gig Tr Prof Zabol, vol 14(6) pg 46, 1970.
2. Aquatic Information Retrieval (ACQUIRE) On-Line Computer Database: Chemical Information System, Inc. Baltimore Md., 1995

Table J-19
Ecological Toxicity Profile for Acetone

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Acetone						
Rat		Oral	Single dose	Death	LD_{50} = 5,340 mg/kg	1
Mouse		Oral	13 weeks	Liver weight change	TDLo = 546 gm/kg	1
Quail		Oral-diet	Single dose	No mortality	LD_{50} > 40,000 ppm	2
Pheasant	2,320 mg/kg/day	Oral-diet	Single dose	Death	LD_{50} > 40,000 ppm	3
Meadow Vole					NOAEL = 19.8 mg/kg/day	5
Red Fox					NOAEL = 4.3 mg/kg/day	5
Bluegill (*Lepomis macrochirus*)		Medium	96 hours	Death	LC_{50} = 8300 mg/L	6
Goldfish		Medium	24 hours	Death	LC_{50} = 5000 mg/L	6
Guppy (*Poecilia reticulata*)		Medium	14 days	Death	LC_{50} = 7032 ppm	6
Clawed toad		Medium	48 hours	Death	LC_{50} = 24 mg/L	6
White dotted mosquito		Medium-static	18 hours	Death	LC_{50} = 6190 mg/L	7
Rat	500 mg/kg/day	Oral-water	95 days	Enhanced nephropathy		4
Rat	1,700 mg/kg/day	Oral-water	13 weeks	Enhanced nephropathy		4
Rat	3,400 mg/kg/day	Oral-water	13 weeks	Minor testis abnormalities		4

Table J-19
(Continued)

Bioconcentration:

- Haddock BCF = 0.69

Environmental Fate:

- Log K_{ow} = -0.24
- Henry's law constant 3.7e-5 atm-m3/mole
- Will volatilize significantly from water (half life in model river (20 hours)
- Does not sorb strongly to soil
- Degrades rapidly in soil
- Rapid biodegradation in water

References:

1. Lewis RJ, Sax's Dangerous Properties of Industrial Materials. Van Nostrand Reinhold, NY, 1992.
2. Hill EF et al, Dietary Toxicities of Environmental Contaminants and Pesticides to Coturnix. Fish and Wildlife Technical Report 2. US Fish and Wildlife Service, 1986.
3. USFWS, Lethal Dietary Toxicities of Environmental Pollutants to Birds. Special Scientific Report- Wildlife No.191, 1975.
4. Agency for Toxic Substances and Disease Control.(ATSDR). Toxicological Profile for Acetone. 1992.
5. Screening Benchmarks for Ecological Risk Assessment, Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge, TN, 1994.
6. Aquatic Information Retrieval (AQUIRE), 1994, On-Line Computer Database: Chemical Information Systems, Inc., Baltimore, Md.
7. Hazardous Substances Data Base (HSDB), 1994, On-Line Computer Database: U.S. Department of Health and Human Services, Bethesda, MD.

Table J-20
Ecological Toxicity Profile for Aluminum

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Aluminum						
Aquatic Systems					NOEL = 87 µg/L	2
Rat		Food	Gd 18-20	Death of pups	LOAEL = 155 mg/kg/day	1
Rat		Water	100 days	Decreased weight gain	LOAEL = 540 mg/kg/day	1

Aluminum is the third most abundant element in nature and is present in air, water, soil, and most foods. It is highly reactive and found naturally only in combination with other substances. Bioconcentration of aluminum in fish is a function of the water quality. It is not expected to bioaccumulate significantly in the food chain. An uptake factor for leafy vegetables has been estimated at 0.004; a BCF for reproductive plant parts has been estimated at 0.00065. Aluminum is not expected to bioconcentrate in plants (3). No data is available on K_{ow} or K_{oc} values.

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Aluminum. October 1990.
2. EPA 1988. Ambient Water Quality Criteria for Aluminum: EPA\440\5-86-008.
3. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Aluminum, Draft. U.S. Dept. and Health and Human Services, Atlanta, GA, October 1990.

Table J-21
Ecological Toxicity Profile for Anthracene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Anthracene						
Rat		Oral		Death	LD_{LO}=20 gm/kg	1
Rat		Subcutaneous		Death	TD_{LO}=3300 mg/kg	1
Mice		Intrarperitoneal injection	Acute	Death	LD_{50}=> 430 mg/kg	2
Rodent	3300 mg/kg	Oral	Chronic	Carcinogenicity		3
Mice	0.08 mg	Applied to skin		Carcinogenic		3
Mouse	17 gm/kg	Oral		Fatty liver degeneration		4
Mouse		Oral		Death	LD_{50}= 430 mg/kg	5

Anthracene is a polycyclic aromatic hydrocarbon (PAH) that is a byproduct of incomplete combustion. In the environment, anthracene adsorbs strongly to soil and sediment (K_{ow}=2.8x10[4], K_{oc}=1.4x10[4]). Immobile in soil, likely to degrade before reaching groundwater. Subject to biodegradation with an estimated $T_{1/2}$ of 108 - 139 days. The majority of tests indicate that anthracene is non-carcinogenic with limited evidence for genotoxicity. A bioconcentration factor (BCF) of 900 has been determined for anthracene.

Bioaccumulation Factor (BAF):
- Earthworm = 0.05 (6)

Bioconcentration Factors (BCF):
- *Daphnia magna* (60 min.) = 200 (3)
- Fathead minnow (2-3 days) = 485 (3)
- *Dapnia pulex* (24 hrs.) = 760-1200 (3)
- Mayfly (*Hexagenia* sp.) (28 hrs.) = 3500 (3)
- Rainbow trout (72 hrs.) = 4400-9200 (3)

References:

1. Lewis R.J., Sax's Dangerous Properties of Industrial Materials. Van Nostrand Reinhold, NY. 1992
2. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Polycyclic Aromatic Hydrocarbons, 1989.
3. Eisler, R. Polycyclic Aromatic Hydrocarbons Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. 1987.
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5. Prog Mutat Res, vol 1, pg 682, 1981.
6. Beyer, W.N. Evaluating Soil Contamination. U.S. Fish and Wildl. Serv., Biol. Rep. 90(2). 25 pp., 1990.

Table J-22
Ecological Toxicity Profile for Antimony

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Antimony						
Rat		Inhalation	63-78 days 4 hours/day	Difficulty conceiving Decreased number of offspring	LOAEL = 209 mg/m^3	1
Rat		Water	746-1342 days	Decreased lifespan	LOAEL = 2 ppm	1
Rat		Inhalation	52 weeks 7 hours/day 5 days/week	Lung neoplasms	LOAEL LEL = 4.2 mg/m^3	1
Rat		Gavage - Water	1 day	Decreased survival	LOAEL = 300 mg/kg/day	1
Freshwater Aquatic Organisms		Medium	Chronic	Proposed AWQC-protective of aquatic life	LOEL = 30 µg/L	2

Antimony is naturally occurring in the earth's crust but is also released in manufacturing, processing and antimony using facilities. Metal smelting, refining, and coal-fired power plants represent most releases. Releases are generally due to volatilization during combustion and can travel far from the original source once airborne. Antimony does not appear to bioconcentrate appreciably in fish and aquatic organisms. Bioconcentration factors range from 0.15 to 390. A study of moles, shrews, rabbits and invertebrates indicated that antimony does not magnify from lower trophic levels in the food chain. (1)

References:
1. Agency for Toxic Substances and Disease Registry (ATSDR). **Toxicological Profile for Antimony**. October 1990.
2. U.S. Environmental Protection Agency (EPA), 1991, **Water Quality Criteria Summary**: Office of Science and Technology, Health, and Ecological Criteria Division, Washington, D.C. May.

Table J-23
Ecological Toxicity Profile for Arsenic

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Arsenic						
Rat		Gavage	1 Day	Death	LD_{50} = 23 mg/kg/day (females)	1
Rabbit		Gavage-water	1 Day	Death	LD_{50} = 50 mg/kg/day	1
Dog		Gavage-water	1 Day	Death	LD_{50} = 15 mg/kg/day	1
Rat		Gavage-water	GD 7-16	33% Mortality of fetuses and 14% of dams	LOAEL = 27.2 mg/kg/day	1
Mouse		Gavage-water	19 Days (3 days/week)	Reduced male fertility	LOAEL = 55 mg/kg/day	1
Pig		Food	30 Days	Seizures in 100% of animals	LOAEL = 0.87 mg/kg/day	1
Marbled salamander		As^{+3}	8 Days	Death and malformations in developing embryos	EC_{50} = 4.5 mg/L	2
Mallard		Sodium arsenate		Death	LD_{50} = 323 mg/kg BW (oral acute value)	2,4
California quail		Sodium arsenate	Single oral dose	Death	LD_{50} = 47.6 mg/kg BW	2
Cow		Arsenic trioxide	Single oral dose	Death	15-45 grams/animal	2
Dog		Sodium arsenite		Death	50-150 mg	2
Guinea pig		Diet as arsanilic acid	25-30 Days	Blindness and optic disc atrophy	350 mg/kg	2
Hamster		Arsenate		Fetal mortality	5 mg/kg BW	2
White-tailed deer		Sodium arsenate		Death	34 mg/kg BW	2
Rats	0,15,31, 62, 125 or 250 mg	Diet as sodium arsenite	2 years	Decreased survival and body weight		3

Table J-23
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Arsenic						
Mice	5 µg/ml	Drinking water as sodium arsenite	2 years	Decreased survival rates and longevity		3
Freshwater Aquatic Organisms		Arsenic III	Chronic		AWQC = 190 µg/L	5
Saltwater Aquatic Organism		Arsenic III	Chronic		AWQC = 36 µg/L	5
Meadow vole					NOAEL = 0.111 mg/kg/day	6
Red Fox					NOAEL = 0.024 mg/kg/day	6
Terrestrial plant	10 mg/kg	In soil		20 % reduction in growth		6

Arsenic is a relatively common element and is present in air, water, soil, plants and in all living tissues. The major uses of arsenic are in the production of herbicides, insecticides, desiccants, wood preservatives and growth stimulants for plants and animals. Arsenic is a teratogen and carcinogen that can traverse placental barriers and produce fetal death and malformations in many species of mammals. There is, however, evidence that arsenic is nutritionally essential and/or beneficial. Arsenic deficiency effects, such as poor growth, reduced survival, and inhibited reproduction, have been recorded in mammals fed diets containing < 0.05 mg/kg arsenic, but not those fed diets with 0.35 mg/kg. Arsenic is bioconcentrated by organisms, but is not biomagnified in the food chain. Arsenic exists in four oxidation states, as inorganic or organic forms. In general, inorganic arsenic compounds are more toxic than organic compounds, and trivalent species are more toxic than pentavalent species. Sodium arsenate is the most prevalent environmental form in fresh water (4). Arsenic may be absorbed by ingestion, inhalation, or through permeation of skin or mucous membranes; cells take up arsenic through an active transport system normally used in phosphate transport. Inorganic arsenicals are oxidized in vivo, bimethylated, and usually excreted rapidly in the urine, but organoarsenicals are usually not subject to similar transformations. The mechanisms of arsenic toxicity differ greatly among chemical species, although all appear to cause similar signs of poisoning. Acute or subacute arsenic exposure can lead to elevated tissue residues, appetite loss, reduced growth, loss of hearing, dermatitis, blindness, degenerative changes in liver and kidney, cancer, chromosomal damage, birth defects and death. Death or malformations have been documented at single oral doses of 2.5 to 33 mg/kg BW, at chronic dose of 1 to 10 mg/kg BW and at dietary levels >5 and <50 mg/kg diet.

Bioconcentration:
Bioconcentration factors (BCF) experimentally determined for arsenic in aquatic organisms are, except for algae, relatively low. The BCF values for inorganic AS^{+3} in most aquatic invertebrates and fish exposed for 21 to 30 days did not exceed 17x; the maximum was 6x for As^{+5}, and 9x for organoarsenicals (2). In general, the BCFs for arsenic in aquatic organisms have been determined to vary from 333-6000 (3). Terrestrial plants may accumulate arsenic by root uptake from the soil or by absorption of airborne arsenic deposited on the leaves, and certain species may accumulate substantial levels (1). The BCF for aquatic plants is 2,200-5,500 (5). Arsenic is phytotoxic. It is chemically similar to phosphorus which is essential for plant growth (5).

References:

1. Agency for Toxicological Substances and Disease Registry (ATSDR). Toxicological Profile for Arsenic. 1991.
2. Eisler, R. Arsenic hazards to Fish, Wildlife, and Invertebrates: a Synoptic Review. U.S. Fish Wildl. Serv. Biol. Rep. 85 (1.12) 1988.
3. Health Effects Assessment for Arsenic. EPA/540/1-86/020, September 1984.
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5. U.S. Environmental Protection Agency (EPA), 1991, **Water Quality Criteria Summary**: Office of Science and Technology, Health, and Ecological Criteria Division, Washington, D.C. May.
6. Screening Benchmarks fro Ecological Risk Assessment, Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge TN, 1994.

Table J-24
Ecological Toxicity Profile for Barium

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Barium						
Rat		Gavage-water	Single dose	Death	LD_{50} = 277 mg/kg/day (males), 269 mg/kg/day (females)	1
Mouse		Oral-water	2 years	Reduced lifespan in males	LOAEL = 0.95 mg/kg/day	1
Rat	18.3 mg/kg/day	Oral as $BaCO_3$	Conception and gestation	Increased mortality of offspring		1
Water flea		Static test	48 hours		LC_{50} = 68000 μg/L	3
Aquatic plant		Static test	32 days	Reduced growth	EC_{50} = 113 mg/L	3
Meadow vole					NOAEL = 10.77 mg/kg/day	4
Red fox					NOAEL = 5.04 mg/kg/day	4
Terrestrial plant	500 mg/kg	Soil		20% reduction in growth		4

Barium is a naturally occurring component of minerals that are found in small but widely distributed amounts in the earth's crust. Barium enters the environment naturally through the weathering of rocks and minerals. Under natural conditions, barium is stable in the +2 valence state and is found primarily in the form of inorganic complexes (1).

Barium is not mobile in most soils and is not bioaccumulated by plants. It reacts with metal oxides and hydroxides in soil and is subsequently adsorbed onto soil particulates (1). The toxicity of barium compounds depends on their solubility. The soluble compounds are absorbed and small amounts are accumulated in the skeleton. The major route of excretion is the feces (2).
A BCF of 120 has been recorded for plankton (1).

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Barium and Compounds. October 1990.
2. Casarett and Doull's Toxicology, The Basic Science of Poisons, Third edition. Klassen. C.D., Amdur, M.O., and J. Doull (Eds.), Macmillan Publishing Co. New York. 1986.
3. Aquatic Information Retrieval (AQUIRE), 1994, On-line Computer Database Information Systems, Inc. Baltimore, MD.
4. Screening Benchmarks fro Ecological Risk Assessment, Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge TN, 1994.

Table J-25
Ecological Toxicity Profile for Benzene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Benzene						
Rat		Inhalation	4 hours	Death	LC_{50} = 13700 ppm	1
Rabbit		Inhalation	GD 7-20, 24 hrs/day	Decreased fetal weight	LOAEL = 313 ppm	1
Mouse		Inhalation	GD 6-15 7 hrs/day	Decreased fetal weight	LOAEL = 500 ppm	1
Rat		Oral - food	1 day	Death	LD_{50} = 930 mg/kg/day	1
Mouse		Gavage - oil	GD 8-12	Decreased fetal weight	LOAEL = 1300 mg/kg/day	1
Freshwater aquatic organism			Acute	Proposed AWQC-protection of aquatic life	LOEL = 5300 µg/L	2
Saltwater aquatic organism			Chronic	Proposed AWQC-protection of aquatic life	LOEL = 700 ug/L	2
Meadow vole					NOAEL = 23.23 mg/kg/day	3
Red fox					NOAEL = 5.04 mg/kg/day	3
Grass Shrimp (*Palaemonetes pugio*)			96 hour	Death	LC_{50} = 27 ppm	4
Bluegill sunfish (*Lepomis macrochirus*)			24-48 hour	Death	LD_{50} = 20 mg/L	4
Goldfish (*Carassius auratus*)			24 hour	Death	LD_{50} = 46 mg/L	4

Table J-25
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Benzene						
Guppy (*Poecilia reticulata*)			14 days	Death	LC_{50} =63 ppm	4

Benzene, also know as benzol, evaporates into air quickly and dissolves easily in water. Benzene found in the environment is from both natural processes and human activities. Natural sources, which includes volcanoes and forest fires, account for a small amount of benzene in the environment. Benzene is also a natural part of crude oil. It is used widely and is ranked in the top 20 in production volume for chemicals produced in the United States. Most of the benzene is produced from petroleum sources. Various industries use benzene to make other chemicals, such as styrene, cumene, and cyclohexane. Benzene is also used for the manufacturing of some types of rubber, lubricants, dyes, detergents, drugs and pesticides.

The high volatility and water solubility of benzene are the physical properties with the greatest influence on environmental transport and partitioning. Benzene released to soil surfaces partitions to the atmosphere through volatilization to surface water through runoff and to groundwater as a result of leaching. Benzene is considered highly mobile. On the basis of a reported log Kow of 2.13 and an esitmated BCF of 24, benzene is not expected to bioconcentrate to any great extent in aquatic organisms. On the basis of estimated and measured BCFs, biomagnification in aquatic food chains does not appear to be important. Evidence exists for the uptake of benzene by cress and barley plants from soil. However, because benzene exists primarily in the vapor phase, root uptake is not expected to be a major source of vegetative contamination. Air to leaf is expected to be the major pathway of vegetative contamination. Benzene is biodegradable in surface water and soil under aerobic conditions (1).

Environmental Fate:
- Henry's Law constant = 5.5×10^{-3} atm.m^3/mole at 20°C
- Solubility in water at 25°C = 1,780 mg/L

Bioconcentration:
- K_{oc} = 60-83
- K_{ow} = 2.13
- General BCF = 24 (estimated)
- BCF for goldfish = 4.27 (1).
- BCF for barley plants = 17
- BCF for cress plants = 10

References:

1. Agency for Toxic Substance and Disease Registry (ATSDR) Toxicological Profile for Benzene. 1991.
2. EPA. Water Quality Criteria Summary. Office of Science and Technology, Health and Ecological Criteria Division, Washington, D.C. Federal Register Notice 57FR60911. 1991.
3. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences & Health Sciences Research Division. Oak Ridge National Labs. Oak Ridge, TN. 1994.
4. Hazardous Substances Data Base. (HSDB). On-line Computer Database. U.S. Department of Health and Human Health Services, Bethesda, MD. 1995.

Table J-26
Ecological Toxicity Profile for Benzo(a)anthracene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Benzo(a)anthracene						
Rat	180 mg/kg	Oral	Acute	Oncogenic transformation		1
Mouse	18 mg/kg	Dermal	Acute	Skin tumors		2
Mouse	2 mg/kg	Subcutaneous	Acute	Tumors at site of application		3
Rat		Intravaneous	1 Injection	Death	LD_{50} > 200 mg/kg	4
Bluegill (*Leponis macrochirus*)		Medium	87 hours	Death	LC_{87} =1000 ug/L	6
Mouse		Dermal	3 per week for 50 weeks	Skin tumors	LOAEL = 0.15 mg/kg-BW	5
Rodent	2 mg/kg	Oral	Chronic	Carcinogenic		6
Mouse	1 mg	Dermal	Not specified	Carcinogenic		6
Mouse	5 mg	Subcutaneous	Single	Carcinogenic		6
Mouse	2 mg	Gavage	2 Days	Increase hepatomas and pulmonary adenomas		7
Mouse	1.5 mg/kg	Gavage	Intermittent over 5 weeks	Increase hepatomas and pulmonary adenomas		7

Benzo(a)anthracene (B(a)a) is a polycyclic aromatic hydrocarbon (PAH) which is a byproduct of incomplete combustion. B(a)a binds strongly to soil and sediment (K_{ow}= 4.1x10^5 and K_{oc}= 2x10^5). Biodegradation is slow in soils and sediment. The half-life is approximately 1 year. B(a)a is not expected to bioconcentrate or bioaccumulate. Laboratory studies on experimental animals indicate that B(a)a is potentially carcinogenic following oral exposure. It has been shown to be carcinogenic following intermediate-term dermal exposure. The majority of genotoxicity test have shown positive results, although some have have also been negative.

Bioaccumulation Factor (BAF):
- Earthworm 0.125 (8)

Bioconcentration Factor (BCF):
- Cladacoeran (*Daphnia pulex*) = 10,109 (24-hr)

References:

1. Cancer Res., vol 40, pg. 1157 (1980).
2. Cancer Res., vol 38, pg. 1699 (1978).
3. Cancer Res., vol 15, pg. 632, (1955).
4. Mol. Pharmacol., vol 4, pg 427, (1968).
5. ICF-Clement, Toxicological Profile for Benz(a)anthracene (1990).
6. Eisler, R. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, Invertebrates: a Synoptic Review. U.S. Fish Wildl. Serv. Biol. Rep. 85(1.11). 81 pp. 1987.
7. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Polycyclic Aromatic Hydrocarbons. 1989.
8. Beyer, W.N. Evaluating Soil Contamination. U.S. Fish and Wildl. Serv., Biol. Rep. 90(2). 25 pp., 1990.

Table J-27
Ecological Toxicity Profile for Benzo(a)pyrene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Benzo(a)pyrene						
Rat		Oral	Acute	Death	LD_{50} = 50 mg/kgBW	1
Rodent	0.002 mg/kg	Oral	Chronic	Tumor formation		1
Mouse	5 mg/kg/d	Oral	Intermediate	Cancer 15 -365 days		1
Mouse	10 mg/kg/d	Oral	GD 7 - 16	Reduced pup weights and reproductive alterations		2
Mouse	5.2 mg/kg/d	Oral-food	110 Days	Forestomach tumors		3
Mouse	33.3 mg/kg/d	Oral-food	Intermediate	Stomach cancer, lung tumors, leukemia		3
Mallard	0.036 ug/ kg-whole egg	PAH mixture applied to external surface of egg		Reduction in embryonic growth, increased number of abnormal survivors		1
Hamster	500 ppm	Oral-food	4 days/week for 14 months	Tumorigenic		4
Mouse		Intraperitoneal	Acute	Death	LD_{50} = 250 mg/kg	5
Duck	50 - 200 mg	Intratracheal		Reduced survival rate		6
Mouse	40 - 160 mg/kg		GD 7 - 16	Female sterility		7
Rat		Oral		Tumorigenic Gastrointestinal Musculo-skelatal	TD_{LO} = 15 mg/kg	8
Mouse		Oral		Tumorigenic, lung and thorax	TD_{LO} = 700 mg/kg	9
Hamster		Oral		Tumorigenic Gastrointestinal	TD_{LO} = 420 mg/kg	10
Meadow Vole					NOAEL = 0.881 mg/kg/day	14

Table J-27
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Benzo(a)pyrene						
Red Fox					NOAEL = 0.191 mg/kg/day	14
Rat		Oral		Embryonic or fetal effects	TD_{LO} = 40 mg/kg	11
Sandworm (*Neanthes grenceodentata*)			96 hour	Death	LC_{50} > 1000 ug/L	1
Mouse		Oral		Decreased litter and male/female sterility	TD_{LO} = 100 mg/kg	12
Mouse	40 mg/kg/d	Gavage	10 days during gestation	Reduced pup weights at 20 days		2

Benzo(a)pyrene B(a)P is a polycyclic aromatic hydrocarbon (PAH) present in the environment as a byproduct of incomplete combustion. Some microbes have also demonstrated the ability to synthesize B(a)P. The majority of B(a)P present in the environment is due to releases into the atmosphere. B(a)P that deposits on land and water will partition primarily to soil and sediment, where it is very persistent (K_{ow}=1.55x10^6 and K_{oc}=5.5x10^6). Biodegradation is the principle route of B(a)P degradation in soil and sediment. The process is slow, with a $T_{1/2}$ of approximately 290 days (soil). B(a)P has been shown to be acutely toxic in high doses. The primary endpoint of concern is cancer. B(a)P has been shown to cause cancer in experimental animals through exposure via inhalation, dermal application and ingestion. In addition, B(a)P is also a recognized genotoxic and mutagenic agent and is a suspected human carcinogen (A2).

Bioaccumulation Factor (BAF):
- Earthworm = 0.342 (13)

Bioconcentration Factor (BCF):
- Clam (*Rongia cuneata*) (24 hrs) = 9-236
- Bluegill (4 hrs.) = 12
- Atlantic salmon, egg (168 hrs) = 71
- Oyster (14 days) = 242
- Northern pike (3.3 hrs) = 3974

References:

1. Eisler, R. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, and Invertebrates: a Synoptic Review. U.S. Fish Wild. Serv. Biol. Rep. 85(1.11). 81pp. 1987.
2. ICF-Clement. Toxicological Profile for Benzo(a)pyrene. 1987.
3 Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Polcyclic Aromatic Hydrocarbons. 1989.
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5. IARC Monographs on the evaluation of carcinogenic risk of chemicals to man. V32 213(1983).
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9. Gig. Sanit., Vol 45(12) (1980).
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13. Beyer, W.N. Evaluating Soil Contamination. U.S. Fish and Wildl. Serv., Biol. Rep. 90(2). 25 pp., 1990.
14. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences & Health Sciences Research Division. Oak Ridge National Labs. Oak Ridge, TN. 1994.

Table J-28
Ecological Toxicity Profile for Benzo(b)fluoranthene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Benzo(b)fluoranthene						
Rodent	40 mg/kg	Oral	Chronic	Carcinogenic		1
Rat	1 mg	Injection into lung	Single application, time release	Lung tumors		2
Mice	1.2 mg/kg	Dermal application	3/week, lifetime	Skin tumors		2
Mice	0.6 mg	Subcutaneous injection	3 injections/ 2 months	Sarcoma		3
Chicken	10 ug/egg	Injection into yolk sac through egg shell	Single injection	Decrease in hatchability		4
Chicken	15 ppm	Injection into developing embryo	Single injection, near term	Decreased survival rate		5

Benzo(b)fluoranthene [B(b)F] is a polycyclic aromatic hydrocarbon (PAH) that is a byproduct of incomplete combustion. In the environment, B(b)F adsorbs strongly to soil and sediment (K_{ow}=1.15x10^6, K_{oc}=5.5x10^5). It is considered immobile in soil. Leaching to groundwater is not expected. Bioaccumulation, especially in vertebrate organisms is considered to be short-term and not considered an important fate process. The major fate of sediment-bound B(b)F is most likely biodegradation. The $T_{1/2}$ in soil is estimated to be approximately 610 days. Limited lethality, systemic or reproductive toxicity data is available for B(b)F. Experimental evidence exists that B(b)F is a skin carcinogen in animals following dermal application or subcutaneous injection. B(b)F is considered a probable human carcinogen.

Bioaccumulation Factor (BAF):
- Earthworm = 0.32 (6)

References:

1. Eisler, R. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, invertebrates: a synoptic review. U.S. Fish Wildl. Serv. Biol. Rep. 85(1.11). 81 pp. 1987.
2. Agency for Toxic Substances and Disease Registry. (ATSDR). Toxicological Profile for Polycyclic Aromatic Hydrocarbons. 1989.
3. Research on Cancer, V# 74 (1973).
4. Toxicol Appl Pharmacol 8(2):351 (1966).
5. Kuwabara, K., et al; Shokuhin Eisei Hen 14: 47-51 (1983).
6. Beyer, W.N. Evaluating Soil Contamination. U.S. Fish and Wildl. Serv., Biol. Rep. 90(2). 25 pp., 1990.

Table J-29
Ecological Toxicity Profile for Benzo(g,h,i)perylene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Benzo(g,h,i)perylene						
Mice	0.8 mg	Dermal		Carcinogenic		1

Benzo(g,h,i)perylene [B(ghi)P] is a polycyclic aromatic hydrocarbon (PAH), that is a byproduct of incomplete combustion. In the environment, B(ghi)P is expected to adsorb strongly to soil and organic materials in sediment (K_{ow}=3.2x10^6, K_{oc}=1.6x10^6). The half-life in aerobic soils is estimated to be approximately 600 days. Limited toxicological data is available specific to B(ghi)P. Some evidence exists that B(ghi)P is genotoxic. The data regarding the carcinogenicity of B(ghi)P is considered inconclusive at this time.

Bioaccumulation Factor (BAF):
- Earthworm = 0.24 (2)

References:

1. Eisler, R. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, invertebrates: a synoptic review. U.S. Fish Wildl. Serv. Biol. Rep. 85(1.11). 81 pp. 1987.
2. Beyer, W.N. Evaluating Soil Contamination. U.S. Fish and Wildl. Serv., Biol. Rep. 90(2). 25 pp., 1990.

Table J-30
Ecological Toxicity Profile for Benzo(k)fluoranthene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Benzo(k)fluoranthene						
Mouse	0.6 mg/injection	Subcutaneous injection	1 injection/month for 3 months	Sarcoma at site of injection		1
Rat	5 mg/kg	Implant		Tumors at site of implant		2
Mouse		Subcutaneous		Tumors at site of injection	TD_{LO} = 72 mg/kg	3
Rodent	72 mg/kg	Oral	Chronic	Carcinogen		4

Benzo(k)fluoranthene [B(k)F] is a polycyclic aromatic hydrocarbon (PAH) that is a byproduct of incomplete combustion. In the environment, B(k)F adsorbs strongly to soil and sediment ($K_{ow}=1.15x10^6$, $K_{oc}=5.5x10^5$). Lethality, systemic and reproductive toxicity data for B(k)F is limited. Experimental data that is available suggests that B(k)F is a weak carcinogen through the oral or dermal route. Studies to date also suggest that B(k)F may be genotoxic and mutagenic.

Boiaccumulation Factor (BAF):
- Earthworm = 0.25 (5)

References:

1. IARC Monographs. V32 15 (1983)
2. Polynucl. Aromatic Hydrocarbons Int. Synp. 7th vol 7, pg 571 (1983).
3. Acta. Unio. Int. Contra. Cancrum. Vol 19 pg 490 (1963)
4. Eisler, R. Polycyclic Aromatic Hydrocarbon Hazards to Fish, Wildlife, Invertebrates: a Synoptic Review. U.S. Fish Wildl. Serv. Biol. Rep. 85(1.11). 81 pp. 1987.
5. Beyer, W.N. Evaluating Soil Contamination. U.S. Fish and Wildl. Serv., Biol. Rep. 90(2). 25 pp., 1990.

Table J-31
Ecological Toxicity Profile for Benzoic Acid

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Benzoic Acid						
Rat		Oral	Single dose	Death	LD_{50} = 2530 mg/kg	1
Mouse		Oral	Single dose	Death	LD_{50} = 1940 mg/kg	1
Dog/cat/rabbit		Oral	Single dose	Death	LD_{50} = 2000 mg/kg	1
Guinea pig		Oral	Single dose	Death	LD_{Lo} = 2 g/kg	1

Benzoic acid has a strong log Kow of 1.87 and does not sorb readily to soils. Biodegradation in water is expected to be between 0.2 and 3.6 days (Sax, 1992).

Bioconcentration Factor (BCF):
- Golden ide and algae < 10
- Mosquito fish = 21
- Mosquito larvae = 138
- Daphnia = 1800
- Snail = 2,800

Environmental fate:
- Log K_{ow} = 1.87, will volatilize significantly from water
- Does not sorb strongly to soil
- soil half life < 1 week
- biodegradation in water (half life 0.2 to 3.6 days)

References:
1. Lewis RJ, 1992. Sax's Dangerous Properties of Industrial Materials. Van Nostrand Reinhold, NY.

Table J-32
Ecological Toxicity Profile for Benzyl Alcohol

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Benzyl Alcohol						
Rat		Oral	One dose	Death	LD_{50} = 1,230 mg/kg	1
Mouse		Oral	One dose	Death	LD_{50} = 1,580 mg/kg	1
Rat		Inhalation	4 hours	Death	LC_{50} = 2,000 ppm	1
Mouse	750 mg/kg/day	Gavage-water	GD 6-13	Decreased birth weight and pup weight gain		2
Rat		Oral	One dose	Death	LD_{50} = 3.1 g/kg	3
Rat		Inhalation	8 hours	Death	LC_{100} = 200-300 ppm	4
Fathead minnow (*Pimephales promelas*)		Medium	48 hours	Death	LC_{50} =770 mg/L	5
Inland silverside (*Menidia beryllina*)		Medium - static	96 hours	Death	LC_{50} =15 mg/L	6
Fathead minnow (juvenile)		Medium - static	1 hour	Death	LC_{50} =770 mg/L	6

Benzyl alcohol is used the manufacturing of other benzyl compounds. It is also used in a variety of other common products such as perfumes, food flavorings, nylon dyes, insect repellents, and cosmetics (1).

Bioconcentration:
- BCF = 4.0 (Calculated)

Environmental Fate:
- Henrys's Law constant = 3.0e-7 atm-m^3/mole
- K_{ow} = 1.1
- K_{oc} = <5 to 15.6
- Half-life in atmosphere = 2 days (estimated)
- Biological half- life = 1.5 hours in dog

References:

1. Lewis R.J., Sax's Dangerous Properties of Industrial Materials. Van Nostrand Reinhold, NY. 1992.
2. Hardin B.D. et al,. Teratog. Carcinog. Mutagen. 7: 29-48, 1987.
3. The Merck Index, 10th ed. Rahway NJ., 1983.
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5. Hazardous Substance Data Base (HSDB) On-line Computer Database: U.S. Department of Health and Human Services, Bethesda, MD, 1995.
6. Aquatic Information Retrieval (ACQUIRE) On-line Computer Database: Chemical Information System, Inc. Baltimore, Md. 1995.

Table J-33
Ecological Toxicity Profile for Beryllium

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Beryllium						
Rat		Gavage as BeF_2	1 day	Death	LD_{50} = 18.8 mg/kg/day as BeF_2	1
Rat		Gavage as BeF_2, BeO	1 day	Death	LD_{50} = 18.3 mg/kg/day	1
Mouse		Gavage-water as $BeSO_4$	1 day	Death	LD_{50} = 140 mg/kg/day	1
Mouse		Gavage as BeF_2	1 day	Death	LD_{50} = 19.1 mg/kg/day	1
Meadow vole					NOAEL = 1.308 mg/kg/day	2
Red fox					NOAEL = 0.284 mg/kg/day	2

Beryllium is a naturally occurring element that is released to the environment by the weathering of rocks and soils. It is also naturally emitted to the atmosphere by windblown dusts and volcanic particles. Fuel oil and coal combustion produce significant emissions. Beryllium is not expected to bioconcentrate or biomagnify in the food chain. Limited mobility in soil is expected due to its tendency to adsorb tightly. Leaching through soil to groundwater is also not expected. A BCF of 19 has been reported in fish (1).

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Beryllium. October 1991.

2. Screening Benchmarks fro Ecological Risk Assessment, Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge TN, 1994.

Table J-34
Ecological Toxicity Profile for BHC (alpha, eta, and delta)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
alpha, beta and delta-BHC						
Rat	0.69-1100 mg/kg/day	Oral	Lifespan	Reduced weight gain, increased mortality, and chronic nephritis at 800 mg/kg. Fatty degeneration and centrilobular liver necrosis at higher doses		1
Mouse	70 mg/kg/day	Oral	26 wk	Histologically benign liver tumors		2
Mouse	12-58 mg/kg/-day	Oral	24 wk	Hepatocellular carcinomas, liver nodular hyperplasia		3
Mouse	29 mg/kg/day	Oral	24 wk	Hepatocellular carcinomas and/or nodular hyperplasia		4
Rat		Oral-food	72 wk	Hepatocellular carcinoma	LOAEL=50 mg/kg/-day	5
Rat		Oral-food	13 weeks as beta	Decreased weight gain	LOAEL = 12.5 mg/kg/day	6
Mouse		Oral-food	30 days as beta	Decreased cell-mediated immunity	LOAEL = 39 mg/kg/day	6
Rat		Oral-food	13 weeks as beta	Atrophy of uterus, ovary, testes	LOAEL = 12.5 mg/kg/day	6
White footed mouse	beta-BHC				NOAEL = 0.997 mg/kg/day	8
Red fox	beta- BHC				NOAEL = 0.172 mg/kg/day	8
Mouse		Oral-food	24 weeks as alpha	Hepatocellular carcinoma	LOAEL = 65 mg/kg/day	6

Table J-34
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
alpha, beta and delta-BHC						
Rat		Oral-food	7 weeks as tech	Decreased sperm count	LOAEL = 50 mg/kg/day	6
Guppy / medaka	32 μg/L	Medium	3 months	Estrogenic activity		7
Meadow vole	Mixed isomers				NOAEL = 3.17 mg/kg/day	8
Red fox	Mixed isomers				NOAEL = 0.008 mg/kg/day	8
American Robin	Mixed isomers				NOAEL = 0.702 mg/kg/day	8
Great Blue Heron	Mixed isomers				NOAEL = 0.226 mg/kg/day	8
Barn Owl	Mixed isomers				NOAEL = 0.387 mg/kg/day	8
Cooper's Hawk	Mixed isomers				NOAEL = 0.395 mg/kg/day	8
Red-tailed Hawk	Mixed isomers				NOAEL = 0.289 mg/kg/day	8
Alga (*Scendesmus acutus*)	alpha - BHC	Medium - freshwater		Growth inhibition	EC = 500 μg/L	9
Water flea (*Daphnia*)	alpha - BHC	Medium		Reduced reproductive efficiency	EC_{50} = 0.1 ppm	9

Table J-34
(Continued)

Technical-grade hexachlorocyclohexane (BHC) has been shown to be well absorbed in the gastrointestinal tract of animals. The toxicity of the isomers varies. With respect to acute exposure, γ BHC (lindane) is the most toxic, followed by α-, δ-, and β-BHC. However, on chronic exposure β-BHC is the most toxic followed by α-, γ-, and δ-BHC. With chronic exposures, the increased toxicity of β-BHC is probably due to its longer half-life in the body and its accumulation in the body with time. The excretion of BHC isomers is primarily through the urine. The primary urinary metabolites are chlorophenols and an epoxide. The conversion occurs mainly by hepatic enzymes. In mice, exposure to 64.6 mg technical grade BHC/kg/day for 3 months led to increased testicular weight and degeneration of seminiferous tubules. α-BHC, β-BHC, γ-BHC and technical-grade BHC have been shown to be liver carcinogens in rats and mice (6). A bioconcentration factor of 1,613 has been calculated for BHC.

alpha - BHC (319-84-6)

- Log K_{ow} = 3.46;
- Log K_{oc} = 3.57;
- Vapor pressure at 20°C = 0.02 mmHg
- Henry's Law = 4.8 x 1^{0-6} atm m^3/mole
- BCF (zebra-fish, steady-state) = 1100 (6)

beta - BHC (319-85-7)

- Log K_{ow} = 4.50;
- Log K_{oc} = 3.57;
- Vapor pressure at 20°C = 0.005 mmHg
- Henry's Law = 4.5 x 10^{-7} atm m^3/mole
- BCF (zebra-fish, steady-fish)= 1460(6)

delta - BHC (319-86-8)

- Log K_{ow} = 2.80;
- Log K_{oc} = 3.8;
- Vapor pressure at 20°C = 0.02 mmHg
- Henry's Law = 2.1 x 10^{-7} atm m^3/mole
- BCF (zebra-fish, steady-state)= 1770 (6)

References:

1. IARC. Monographs of the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer 1972-Present (multivoume work). V20 217 (1979).
2. IARC. Monographs of the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer 1972-Present (multivoume work). V20 208 (1979).
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6. Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for alpha, beta, gamma, and delta-Hexachlorocyclohexane. 1994.
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8. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences & Health Sciences Research Division. Oak Ridge National Labs, Oak Ridge, TN. 1994.
9. Hazardous Substances Data Bank (HSDB). On-line Computer Database: U.S. Department of Health and Human Services, Bethesda, MD. 1995.

Table J-35
Ecological Toxicity Profile for BHC (gamma) Lindane

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
gamma-BHC (Lindane)						
Rat		Gavage	One time	Death	LD_{50} = 88 mg/kg/day	1
Rat		Gavage-oil	One time	Decreased sexual receptivity	LOAEL = 33 mg/kg/day	1
Rabbit		Capsule	5-6 weeks	Suppressed antibody response	LOAEL = 1.5 mg/kg/day	1
Rat		Oral-food	90 days	Disrupted spermatogenesis, testicular atrophy	LOAEL = 75 mg/kg/day	1
Mallard					LD_{50} = >2,000 mg/kg	2
Bobwhite quail		Oral	Acute		LD_{50} = 120-130 mg/kg	3
Mallard		Applied to eggs	One time	Death, birth defects, stunted growth	LC_{50} = 74,000 mg/L	4
Meadow vole					NOAEL = 15.8 mg/kg/day	5
Red fox					NOAEL = 3.44 mg/kg/day	5
American robin					NOAEL = 4.66 mg/kg/day	5
Cooper's hawk					NOAEL = 2.62 mg/kg/day	5
Red-tailed hawk					NOAEL = 1.92 mg/kg/day	5
Japanese quail		Oral - diet		Death	LC_{50} = 425 ppm	6
Water flea (*Daphnia pulex*)			48 hr		LC_{48} = 460 μg/L	6

Table J-35
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
gamma-BHC (Lindane)						
Insect larvae (*Chaoborus*)			48 hr		LC_{50} = 0.008 ppm	6
Gastropod (*Lymnea stagnalis*)			48 hr		LC_{50} =7.3 ppm	6
Fathead minnow		96 hour		Death	LC_{50} =87 μg/L	6
Coho Salmon		96 hour		Death	LC_{50} =23 μg/L	6

Lindane is used as an insecticide and as a therapeutic scabicide, pediculocide, and ectoparasiticide for humans and animals. As an insecticide, it is used on fruit and vegetable crops, for seed treatment, in forestry and for animal treatment. EPA no longer permits the use of lindane for purposes involving direct aquatic application. Direct supervision is required for certain applications of lindane on livestock, structures, and domestic pets. Once released into the environment, BHCs can partition to all environmental media. Biodegradation is believed to be the dominant decomposition process for BHCs in soil and water. Lindane can leach from soil to groundwater, sorb to soil particles, or volatilize to the atmosphere. Lindane is bioconcentrated to high levels following uptake from surface waters by a number of aquatic organisms. Bioconcentration factors (BCFs) for lindane from surface waters include 183 in brine shrimp, 319 in rainbow trout fry, 84 in pink shrimp, 490 in sheepshead minnows, and 1,273 in prawns. Lindane and isomers do not undergo biomagnification in terrestrial food chains to a great extent due to metabolism by terrestrial and aquatic organisms.

Technical-grade BHC has been shown to be well absorbed in the gastrointestinal tract of animals. The toxicity of the isomers varies. With respect to acute exposure, γ BHC (lindane) is the most toxic, followed by α-, δ-, and β-BHC. However, chronic exposure to β-BHC is the most toxic, followed by α-, γ-, and δ-BHC. With chronic exposures, the increased toxicity of β-BHC is probably due to its longer half-life in the body and its accumulation in the body with time. The excretion of BHC isomers is primarily through the urine. The primary urinary metabolites are chlorophenols and an epoxide. The conversion occurs mainly by hepatic enzymes. Lindane has not been reported to cause fetotoxicity in animals. In mice, exposure to 64.6 mg technical grade BHC/kg/day for 3 months led to increased testicular weight and degeneration of seminiferous tubules. α-BHC, β-BHC, γ-BHC and technical-grade BHC have been shown to be liver carcinogens in rats and mice (1).

Environmental Fate:
Log K_{ow} = 3.3
Vapor pressure = 9.4×10^{-6} mmHg
Henry's Law Constant = 3.2×10^{-6} m^3/mole

Bioaccumulation Factor (BAF) for γ-BHC:
- Earthworm = 4.2 (7)

References:

1. Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for alpha, beta, gamma, and delta-Hexachlorocyclohexane. 1992.
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3. Worthing, C.R. and S.B. Walker. The Pesticide Manual, A World Compendium. Seventh edition, The British Crop Protection Council, 1983.
4. Hoffman, D.J. "Measurements of Toxicity and Critical Stages of Development, Wildlife Toxicity and Population Modeling" in: Integrated Studies of Agroecosystems, R.J. Kendal and T.E. Lacher, Jr., Eds., Lewis Publishers, 1994.
5. Screening Benchmarks for Ecological Risk Assessement. Environmental Sciences & Health Sciences Research Division. Oak Ridge National Labs, Oak Ridge, TN. 1994.
6. Hazardous Substance Data Base (HSDB) On-line Computer Database. U.S. Department of Health and Human Services, Bethesda, MD. 1995.
7. Beyer, W. N. "Evaluating Soil Contamination" U.S. Fish Wildl. Serv., Biol. Rep., 90 (2), 25pp., 1990.

Table J-36
Ecological Toxicity Profile for Bis(2-ethylhexyl)phthalate

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Bis(2-ethylhexyl)phthalate						
Rat		Oral-Food	2 weeks	Increased liver weight	LOAEL = 100 mg/kg/d	1
Rat		Oral-Food	2 weeks	Increased liver weight	NOAEL = 25 mg/kg/d	1
Rat		Oral-Food	9 months	Liver alterations	LOAEL = 50 mg/kg/d	1
Hamster		Oral-Food	2 weeks	Increased liver weight	LOAEL = 1,000 mg/kg/d	1
Guinea pigs		Oral-Food	1 Year	Increased liver weight	LOAEL = 19 mg/kg	1
Rat		Single dose	GD 7	Decreased fetal weight	LOAEL = 49.3 mg/kg	1
Mice	98.6 mg/Kg	Single dose	GD 7	Death, deformations		1
Rat		Oral-Food	GD 0-20	Decreased fetus weight and deformations	LOAEL = 357 mg/kg	1
Mice		Oral-Food	GD 0-17	Major malformations	LOAEL = 91 mg/kg/d	1
Rat		Oral-Food	60 days	Decreased body and testicular weight	LOAEL = 250 mg/kg/d	1
Mice		Oral-Food	105 days	Fertility suppressed	LOAEL = 13 mg/kg/d	1
Rat		Oral-Food	2 Years	Seminiferous tube deformation	LOAEL = 674 mg/kg/d	1
Meadow Vole					NOAEL = 16.15 mg/kg/day	3
Red Fox					NOAEL = 3.5 mg/kg/day	3

Table J-36
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Bis(2-ethylhexyl)phthalate						
America Robin					NOAEL = 1.39 mg/kg/day	3
Belted Kingfisher					NOAEL = 1.127 mg/kg/day	3
Great Blue Heron					NOAEL = 0.45 mg/kg/day	3
Cooper's Hawk					NOAEL = 0.78 mg/kg/day	3
Red Tailed Hawk					NOAEL = 0.577 mg/kg/day	3
Guinea pigs		Oral-Food	1 Year	Increased liver weight	LOAEL = 19 mg/kg/d	1
Rainbow trout		Medium	96-hour flow through	Death	LC_{50} = 540 mg/L	2

Bis(2-ethylhexyl)phthalate (DEHP) is a chemical used commonly throughout industry as a plasticizer in flexible PVC products. DEHP enters the environment due to releases (air, water, soils) during production, use and disposal. It is ubiquitous in the environment at low concentrations. It binds strongly to soil and sediment (log K_{ow}=4.88). Biodegradation, is the principle route of environmental degradation ($T_{1/2}$ estimated at several weeks - months). When administered by oral, intraperitoneal, intravenous, and inhalation routes, DEHP has a low acute toxicity. Sufficient evidence from experimental animal studies to conclude that DEHP is a carcinogen. Orally administered DEHP has been shown to cause cancer in rats and mice (liver). In rats and mice, DEHP has also been shown to be a developmental toxin. Considerable research has not shown convincing evidence that DEHP is mutagenic in bacterial or mammalian test systems. The EPA has concluded that DEHP is a probable human carcinogen (B2) (1). A bioconcentration factor for DEHP of 57 has been reported (1).

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Di(2-ethylhexyl)phthalate. 1989.
2. Woodward, K.N. Phthalate Esters: Toxicity and Metabolism Volume II. CRC Press, Inc, Boca Raton, Florida 1988.
3. Screening Benchmarks for Ecological Risk Assessment, Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge, TN, 1994.

Table J-37
Ecological Toxicity Profile for Cadmium

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Cadmium						
Sheepshead Minnow (*Cyprinodon vareigatus*)	5.8 μg/L	Medium	Eggs exposed 7.5 days following fertilization	Early hatching	LOAEL = 5.8 μg/L	1
Rat		Oral-food	GD 6-15	Developmental	NOAEL = 12.5 mg/kg/day	2
Rat		Gavage-water	GD 7-16	Delayed ossification	LOAEL = 2 mg/kg/day	2
Rat		Gavage-water	GD 6-15	Malformations	LOAEL = 18.4 mg/kg/day	2
Rat		Gavage-water	One dose	Reproductive	NOAEL = 50 mg/kg/day	2
Rat		Gavage-water	GD 7-16	Reproductive-increased resorptions	LOAEL = 2 mg/kg/day	2
Rat		Gavage-water	1/day;10 days	Testicular necrosis	LOAEL = 66 mg/kg/day	2
Mouse		Gavage-water	One dose	Testicular necrosis	LOAEL = 60 mg/kg/day	2
Rat		Oral-water	GD 0-20	Developmental	NOAEL = 21 mg/kg/day	2
Rat		Oral-water	GD 0-21	Anemia	LOAEL = 1.4 mg/kg/day	2
Mouse		Water	GD 1-19	Reduced fetal weight	LOAEL = 1.9 mg/kg/day	2
Rat		Gavage-water	1/day; 6-9 weeks	Reduced fertility	LOAEL = 1.0 mg/kg/day	2

Table J-37
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Cadmium						
Rat		Oral-food	21-25 days	Reproductive	NOAEL = 19.7 mg/kg/day	2
Freshwater aquatic organism			Chronic	Protection of aquatic life	AWQC = 1.1 ug/L	10
Saltwater aquatic organism			Chronic	Protection of aquatic life	AWQC = 9.3 ug/L	10
Brook trout (*Salvelinus fontihalis*)			290 hours	Death	LC_{50} = 6 ug/L	7
Flag fish (*Jordanella floridae*)	8.1 μg/L	Medium	96 hours	Reproduction inhibited		8
Flag fish (*Jordanella floridae*)		Medium	96 hours	Death	LC_{50} = 2500 ug/L	8
Plankton (*Cyclops viridis*)		Medium	96 hours, pH = 7.0	Death	LC_{50} = 6.40 ppm	4
Salmo gairdnerii		Medium	7 days	Death	LC_{50} = 0.01 ppm	3
Mallard	20 ppm	Oral - food	90 days	Gonad alterations		5
Chicken	60 ppm	Oral - food		Suppressed egg production		6
Terrestrial Plant		Soil		20% reduction in plant growth	LOEC = 3 mg/kg	11

Table J-37
(Continued)

Cadmium is an element that occurs naturally in the earth's crust. It is a soft metal when pure, but is not usually found in the environment in this form as it usually combined with other elements. These compounds are solids that may be water soluble but do not evaporate or degrade. Most cadmium used in the U.S. is extracted during the production of other metals and subsequently used in industry and consumer products (2).

Cadmium may be released into the environment during combustion of coal and household wastes, and during metal mining and refining. Disposal of waste waters, application of fertilizers, and leaching and spills from hazardous waste sites can lead to cadmium contamination of water. Cadmium may be found as particulates in air. Cadmium does not degrade in the environment, although it may be converted to different forms. It is fairly tenacious once deposited in the environment, but plants, fish, and animals are able to take up cadmium from their environment. A BCF of 2213 has been reported for cadmium in fish (2). A BAF of 21 has been reported for for Cadmium in earthworms (12).

Cadmium does not seem to be bound to specific soil components or to be correlated to any of the usual soil characteristics. However, it is probable that high contents of clay, silt, organics, iron and manganese oxides, and a high soil pH indicate a high capacity for sorbing cadmium. The most important governing factors in plant uptake of cadmium from soil seem, in general, to be the soil pH, texture, and cadmium concentration. The ability to retain and accumulate cadmium is relatively high in certain species. Especially sensitive to cadmium uptake are some fungi, lichens and mosses, different leafy plant parts, earthworms and certain animal organs such as kidneys and livers from birds and mammals. It has been found that the formation of Cd-binding proteins takes place in earthworms. Mammals and birds whose diets include earthworms, e.g., the badger (*Meles meles*) and the tawny owl (*Strix aluco*) have been found to contain cadmium concentrations considerably in excess of background levels. Accumulation is slow, and primarily reflects the feeding habits and longevity of animals (7).

References:

1. Meteyer, Marc J., David A. Wright, and F. Douglas Martin. 1988. Effect of Cadmium on Early Developmental Stages of the Sheepshead Minnow (*Cyprinodon variegatus*). Environmental Toxicology and Chemistry, Vol. 7, pp. 321-328.
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9. Tjell, J.C. Christensen, T.H. and F. Bro-Rasmussen. "Cadmium in Soil and Terrestrial Biota, with Emphasis on the Danish Situation." Ecotoxicology and Env. Safety (7)122-140. 1983.
10. EPA Water Quality Criteria Summary. Office of Science and Technology, Health and Ecological Criteria Division. Washington, D.C., Federal Register Notice 57FR60848. 1991.
11. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences & Health Sciences Research Division. Oak Ridge National Labs. Oak Ridge, TN. 1994.
12. Beyer, W. N. "Evaluating Soil Contamination" U.S. Fish Wildl. Serv., Biol. Rep., 90 (2), 25pp., 1990.

Table J-38
Ecological Toxicity Profile for Chlorobenzene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Chlorobenzene						
Mouse		Inhalation	2 hours	Death	LC_{50} = 4300 ppm	1
Rat		Oral (Gavage)	91 days 5 days/week	Liver necrosis	LOAEL = 250 mg/kg/day	1
Mouse		Oral (Gavage)	91 days 5 days/week	Liver, kidney, and thymic necrosis, splenic depletion	LOAEL = 250 mg/kg/day	1
Rat		Oral (Gavage)	103 weeks 5 days/week 1 time/day	Liver necrosis	LOAEL = 120 mg/kg/day	1
Cat		Inhalation	7 hours	Death	LC_{50} = 3700 ppm	1
Rat		Oral - gavage	14 days - 1x/day	Death	LOAEL =1000 mg/kg/day	1
Guppy (*Poecilia reticulata*)		Medium	14 days	Death	LC_{50} = 19 ppm	2
Rainbow trout (*Salmo gairdnerii*)			24 hours	Death	LD_{50} = 1.8 mg/kg	2
Fathead minnow (*Pimephales promelas*)		Medium-slow-through	96 hours	Death	LC_{50} = 16.9 mg/L	2

Table J-38
(Continued)

Chlorobenzene is used as a solvent and as a chemical intermediate in industry. Chlorobenzene adsorbs moderately to soil and is biodegraded comparatively rapidly. The compound persists in soil for several months, air for approximately 3 days and in water for less than a day (1).

Bioconcentration Factor (BCF):
- Log BCF = 0.79
- Log BCF = 1.84
- BCF = 69.7

Environmental Fate:
- Log K_{ow} = 2.84
- Log K_{oc} = 2.52
- Vapor pressure at 20°C = 8.8 mmHg
- Henry's law constant = 3.58×10^{-3} atm-m^3/mole

References:
1. Agency for Toxic Substance and Disease Registry (ATSDR) Toxicological Profile for Chlorobenzene. 1989.
2. Hazardous Substances Data Base (HSDB), 1994, On-Line Computer Database: U.S. Department of Health and Human Services, Bethesda, MD.

Table J-39
Ecological Toxicity Profile for Chloroethane

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Chloroethane						
Rat		Inhalation	102 weeks, 5 day/wk, 6 hours/day	Reproductive	NOAEL = 15,000 ppm	1
Mouse		Inhalation	100 weeks, 5 day/wk, 6 hours/day	Reproductive	NOAEL = 15,000 ppm	1
Mouse		Inhalation		Cancer effect level (uterus, liver, lungs)	LOAEL = 15,000	1

The high vapor pressure and volatility from water suggest that this compound would evaporate rapidly from soil surfaces and that volatilization would be a major removal process. The relatively low K_{oc} values for chloroethane indicate that this compound is highly mobile in soil and may undergo significant leaching (1).

Bioconcentration:
- BCF = 7.5 based on K_{ow} and water solubility (1).

Environmental Fate:
- Log K_{ow} = 1.43
- Log K_{oc} = 1.52
- Vapor Pressure at 20°C = 1,008 mmHg
- Henry's Law Constant at 24.8°C = 1.11×10^{-2} atm-m^3/moL
- Water solubility = 5,678 mg/L at 20°C

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Chloroethane, 1989.

Table J-40
Ecological Toxicity Profile for Chloroform

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Chloroform						
Rat (F)		Inhalation	4 hours	Death	LC_{50} = 9,770 ppm	1
Mouse (F)		Inhalation	9 hours	Death (50% mortality)	LOAEL = 4,500 ppm	1
Rat (M)		Inhalation	6 months 5 days/week 7 hours/day	Increased Mortality (60%)	LOAEL = 85 ppm	1
Rat		Inhalation	10 days GD 6-15, 7 hr/day	73% decreased conception rate	LOAEL = 300 ppm	1
Mouse		Inhalation	8 days GD 8-15, 7 hr/day	30-48% decreased ability to maintain pregnancy	LOAEL = 100 ppm	1
Rat (M)		Oral (Gavage)	1 time	Death	LD_{50} = 908 mg/kg/day	1
Mouse		Oral (Gavage)	1 time	Death	LD_{50} = 1,100 mg/kg/day	1
Rabbit		Oral (Gavage)	13 days GD 6-18, 1 time	Abortion	LOAEL = 63 mg/kg/day	1
Rat		Oral (Gavage)	78 weeks 5 days/week 1 time/day	Decreased survival	LOAEL = 90 mg/kg/day	1
Daphnia magna			48 hours	Static test	LC_{50} = 28,900 µg/L	2
Rainbow trout			96 hours	Static test	LC_{50} = 43,800 µg/L	2

Table J-40
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Chloroform						
Bluegill			96 hours	Static test	LC_{50} = 115,000 µg/L	2
Pink shrimp			96 hours	Static test	LC_{50} = 81,500 µg/L	2
Rainbow trout (embryo)	10,600 µg/L		23 days	40% teratogenesis		2
Pink shrimp (*Penaeus duorarum*)		Medium - static	96 hours	Death	LC_{50} = 81.5 mg/L	3
Blue gill (*Lepomis macrochirus*)		Medium - static	96 hours	Death	LC_{50} = 43.8 mg/L	3
Water flea (*Daphnia magna*)		Medium - static	48 hours		LC_{50} = 28.9 mg/L	3
Rainbow trout (*Salmo gairdneri*)		Medium - flow-through	27 Days	40% teratogenesis	LC_{50} = 2.03 mg/L	3
Meadow vole					NOAEL = 29.7 mg/kg/day	4
Red fox					NOAEL = 6.4 mg/kg/day	4
Freshwater organisms			Chronic	Proposed AWQC - protective of aquatic life	LOEL = 1240 µg/L	5

Table J-40
(Continued)

Significant effects are not expected in terrestrial or aquatic ecosystems rapidly diluted and degraded to low concentrations in the troposphere. Acute effects on wildlife can occur in the vicinity of major chloroform spills, but signs of chronic effects from long term exposure to low ambient levels is unlikely.

Environmental Fate:
- Log K_{ow} = 1.92
- K_{oc} = 45
- Vapor Pressure at 20°C = 159 mmHg
- Henry's Law Constant at 20°C = 3.0 x 10^{-3} atm/m^3/mol

Bioconcentration Factors (BCF):
- Bluegill sunfish = 6 and 8
- Green algae = 690

References:
1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Chloroform, 1991.
2. EPA Health Assessment Document for Chloroform. EPA-600/8-84-004 A. March 1984.
3. Hazardous Substances Data Base (HSDB), 1994, On-Line Computer Database. U.S. Department o Health and Humans Services, Bethesda, MD.
4. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences and Health Sciences Research Division. Oak Ridge National Labs, Oak Ridge, TN, 1994.
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Table J-41
Ecological Toxicity Profile for Chloromethane

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Chloromethane						
Mouse		Inhalation	6 hours	Death	LC_{50} = 2,200 ppm	1
Rat		Inhalation	2-3 days 24 hours/day	Kidney failure	LOAEL = 1,000 ppm	1
Mouse		Inhalation	12 months 5 days/week 6 hours/day	Increased mortality	LOAEL = 1,000 ppm	1
Mouse		Inhalation	12 days 6 hours/day GD 6-17	Heart defect in fetuses	LOAEL = 500 ppm	1
Rat		Inhalation	18 months 5 days/week 6 hours/day	Testicular atrophy	LOAEL = 1,000 ppm	1
Bluegill (*Lepomis macrochirus*)		Medium - static	96 hours	Death	LC_{50} = 550 mg/L	2
Inland silverside (*Menidia beryllina*)		Medium - static	96 hours	Death	LC_{50} =27 mg/L	2

Bioconcentration:
- BCF = 2.88

Environmental Fate:
- Log K_{ow} = 0.91
- Log K_{oc} = 0.7
- Vapor Pressure at 25°C = 4,309.7 mmHg
- Henry's Law Constant at 25°C = 8.82×10^{-3} atm/m³/moL

References:
1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Chloromethane, 1990.
2. Aquatic Information Regtieval (AQUIRE) On-line Computer Database. Chemcial Information System, Inc., Baltimore, MD. 1995.

Table J-42
Ecological Toxicity Profile for Chromium

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Chromium						
Rat		Gavage	One time as $Cr(No_3)_3 \cdot 9H_2O$ (III)	Death	LD_{50} = 200 mg/kg/day (males), 183 mg/kg/day (females)	1
Rat		Gavage	One time as $CaCrO_4$ (VI)	Death	LD_{50} = 108 mg/kg/day (female), 249 mg/kg/day (male)	1
Mouse		Oral-water	19 days as $K_2Cr_2O_7$ (VI)	Decreased maternal weight gain	LOAEL = 120 mg/kg/day	1
Rat		Oral-water	28 days as Na_2CrO_4 (VI)	Decreased motor activity	LOAEL = 98 mg/kg/day	1
Mouse		Oral-food	7 weeks as $K_2Cr_2O_7$ (VI)	Decreased spermatogenesis	LOAEL = 4.6 mg/kg/day	1
Mouse		Oral-food	7 weeks as $Cr_2(SO_4)_3$ (III)	Decreased spermatogenesis	LOAEL = 3.5 mg/kg/day	1
American Black Duck	10-50 mg/kg	Oral-food	5 months as $CrK(SO_4)_2 \cdot 12H_2O$	Reduced survival		4
Chicken (immature)	2,000 mg/kg	Oral-diet	21 days as $CrCl_3$	Reduced growth		3
Rabbits	1.7 mg/kg	Daily	6 weeks as Cr^{+3}, and Cr^{+6}	Morphological changes in liver		4
Fathead minnow		Flow through medium	96 hours as Cr^{+6}	Death	LC_{50} = 36.9 mg/L	6
Fathead minnow		Medium	96 hours as Cr^{+6}	Death	LC_{50} = 5.07 ppm	5

Table J-42
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Chromium						
Plankton (*Cyclops viridis*)		Medium	pH = 6.0	Death	LC_{50} = 92.5 ppm	7
Diatomes	0.032 - 0.32 ppm	Medium		Growth inhibition		5
Earthworm (*Octochaetus pattoni*)	Chromium VI		60 days		LD_{50} = 15.14 ppm	8

Chromium is a metallic element with oxidation states ranging from (-II) to (+VI). The important valence states of chromium are (II), (III), and (VI). Elemental chromium (0), does not occur naturally. The divalent state (II) is relatively unstable and is readily oxidized to the trivalent (III) state. Chromium compounds are stable in the trivalent state and occur in nature in this state in ores. In most soils, chromium will be present predominantly in the chromium (III) state. The hexavalent (VI) is the second most stable state. However, hexavalent chromium rarely occurs naturally, but is produced from anthropogenic sources. Chromium released into the environment from combustion processes and ore processing industries is present mainly as insoluble chromium (III) oxide. Chromium in the aquatic phase occurs in the soluble state or as suspended solids adsorbed onto clayish materials, organics, or iron oxides. Speciation in groundwater depends on the redox potential and pH condition in the aquifer. Chromium (VI) predominates under high oxidation conditions; whereas chromium (III) predominates under reducing conditions (1). Chromium (VI) is very soluble in natural water and can readily penetrate biological membranes. Freshwater data indicate that increased water hardness significantly decreases the acute toxicity of chromium (III), but does not affect the toxicity of chromium (VI) (2).

Chromium has a low mobility for translocation from roots to the aboveground parts of plants. A Bioconcentration Factor (BCF) of 86 has been determined for Chromium in bottom feeder bi-valves (1). There is no indication of biomagnification of chromium along the aquatic food chain (1). Chromium (III) is essential in animal nutrition as a constituent of glucose tolerance factor (GTF). Chromium (VI) is rarely found in living systems (3). Oral exposure to chromium (VI) compounds cause severe developmental effects in mice. Exposure of pregnant mice to 57 mg chromium (VI)/kg/day as potassium dichromate in drinking water during gestation resulted in embryolethal effects and gross abnormalities. The incidence and severity of abnormalities increased at higher doses. Maternal toxicity, evidenced by decreased body weight gain, occurred at doses >120 mg Cr(VI)/kg/day. Chromium (III) does not appear to cause fetotoxic or teratogenic effects in rats (1). Teratogenic effects were documented in chicken embryos after eggs had been injected with Chromium (VI). Chromium is associated with mutations and malignancy and under appropriate conditions, chromium is a carcinogenic agent (4).

References:
1. Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for Chromium. 1991.
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3. Mineral Tolerance of Domestic Animals, National Academy of Sciences. Washington D.C., 1980.
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Table J-43
Ecological Toxicity Profile for Chrysene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Chrysene						
Rodent	99 mg/kg	Oral	Chronic	Carcinogenicity	Not Specified	1
Rat	100 mg/kg/day	Dermal	17 Months	Benign and malignant skin tumors	Not Specified	2
Rat	100 mg/kg-/day	Intra-gastrically	4 Days	Induction of hepatic aldehyde dehydrogenase	Not Specified	2
Rat	50 mg/kg/day	Intra-gastrically	NA	Induction of hepatic carboxylesterase	Not Specified	2
Mallard	0.27 µg/kg whole egg	PAH mixture applied to the external surface of the egg	Not Specified	Reduction in embryonic growth, increased number of abnormal survivors	Not Specified	1
Carp (*Cyprinus carpio*)		Oral-diet	43 Hours	Death	EC = 190-218 mg/kg	3
Chinook salmon (*Oncorhynchus tshawtscha*)		Medium - static	24 Hours	Death	EC = 10000 µg/L	3
Water flea (*Daphnia magna*)		Medium - renewal	24 Hours	Death	LC_{50} = 0.7 µg/L	3
Northern squawfish (*Ptychocheilus oregonesis*)		Medium-static	24 Hours	Death	EC = 10000 µg/L	3

Chrysene is one of the polycyclic aromatic hydrocarbons (PAHs). Chrysene is present in the environment due to natural and man-made sources. Combustion is the primary source of chrysene in the environment. Chrysene is persistent in the environment, partitioning to soil and sediment (K_{ow}=4.1x10^5, K_{oc}=2x10^5 and Log K_{ow} = 5.61). The potential exists for bioaccumulation. A Bioconcentration Factor (BCF) for chrysene has been determined to be 10,816. A Bioconcentration Factor (BAF) for earthworms has ben determined to be 0.07 (4). Biodegradation occurs in soils and sediment at a slow rate ($t_{1/2}$=1,000 days). Limited toxicological data specific to chrysene is available. At relatively high concentrations, ingestion of chrysene is fatal to rats and mice. Experimental evidence suggests that chrysene is weak carcinogen. Moderate evidence supports the conclusion that chrysene is a skin carcinogen in experimental animals. Chrysene has been shown to be genotoxic in some test systems. The evidence is considered weakly positive.

References:

1. Eisler, R. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, and invertebrates: a synoptic review. U.S. Fish Wild. Serv. Biol. Rep. 85(1.11). 81pp. 1987.
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3. Aquatic Information Retrieval (AQUIRE), 1995, On-line Computer Database: Chemical Information Systems, Inc. Baltimore, MD.
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Table J-44
Ecological Toxicity Profile for Cobalt

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Cobalt						
Rat		Gavage-oil	1 day	Death	LD_{50} = 91 mg/kg/day	1
Rat		Gavage-water	1 day	Death	LD_{50} = 161 mg/kg/day	1
Rat		Gavage	Gestation day 14 to lactation day 21	Stunted growth of pups	LOAEL = 5.4 mg/kg/day	1
Rat		Oral-food	98 days	Testicular degeneration	LOAEL = 13.25 mg/kg/day	1
Rat		Oral-food	69 days	Testicular atrophy	LOAEL = 20 mg/kg/day	1
Mouse		Oral-water	13 weeks	Testicular degeneration	LOAEL = 5.7 mg/kg/day	1
Tench (*Tinca tinca*)			7 Days	Death	EC = 125 mg/L	4
Minnow (*Cyprinidae*)			7 Days	Death	EC = 100 mg/L	4

The sources of cobalt in the environment are both natural and man-made. Natural sources are soil and natural dust, seawater spray, volcanic eruptions, forest fires and other continental and marine biogenic emissions. Primary anthropogenic sources include fossil fuel burning, vehicular and aircraft exhaust, processing of cobalt and cobalt-containing alloys, copper and nickel smelting and refining. The fate of cobalt in the atmosphere depends on the nature of speciation, particle size, and density of the particles. In most waters, sediment is the primary repository for cobalt.

Cobalt appears not to significantly bioaccumulate in benthic bottom feeders in comparison to its concentration in sediment. The bioaccumulation of cobalt ranged from 100 to 4,000 in marine fish and 40-1,000 in freshwater fish. There is little biomagnifaction of cobalt in animals of higher trophic levels. The mobility of cobalt in soil depends on the nature of the soil; it is increased by chelating/complexing agents, ph, and redox potential. Cobalt may leach from soil to groundwater under a combination of these favorable conditions. In most soils, the transfer of cobalt from soil to plants is not appreciable (1).

Cobalt is a dietary essential for ruminants, which use it for synthesis of vitamin B_{12}. Nonruminants poses only limited capacity to use the mineral to synthesize the vitamin. Signs of toxicosis in ruminants are reduced feed intake, emaciation, anemia, debility, increased hemoglobin and packed cell volume, and elevated liver cobalt. Toxic levels appear to be at least 300 times the requirement (2). Polycythemia is the characteristic response of most mammals to ingestion of excessive amounts of cobalt (3).

References:

1. Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for Cobalt, 1990.
2. Mineral Tolerance of Domestic Animals. National Academy of Sciences, Washington D.C., 1980.
3. Casarett and Doull's Toxicology, The Basic Science of Poisons, third edition, Klassen, C.D., Amdur, M.O., and J. Doull (Eds.) Macmillan Publishing Co. New York, 1986.
4. Aquatic Information Retrieval (AQUIRE), 1995, On-line Computer Database: Chemical Information Systems, Inc. Baltimore, MD.

Table J-45
Ecological Toxicity Profile for Cooper

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Copper						
Rat		Oral-food	2 weeks	Death in weanling rats	LOAEL = 300 mg/kg/d	1
Rat		Oral-food	2-15 weeks	Chronic Hepatitis	LOAEL = 300 mg/kg/d	1
Mink		Oral-food	50 weeks	Increased Mortality	LOAEL = 3.2 mg/kg/d	1
Mouse		Oral-water	850 days	Decreased Survival	LOAEL = 42.5 mg/kg/d	1
Sheep-Ewes	50 mg	Subcutaneous	Single dose	3% mortality within 24-72 hours		2
Cattle	300 ppm	Oral-food	129 days	Hemolytic crisis; icterus hemoglobinuria; death		2
Australian fresh-water shrimp		Medium	216 hours	death	LC_{50} = 29 µg/L	6
Fathead minnow		Medium, pH 6-6.5		death	LC_{50} = 15 µg/L	7
Fathead minnow		Medium	96 hours	death	LC_{50} = 0.48 mg/L	8

Copper and its compounds are naturally present in the environment and background levels should be distinguished from high levels that occur from anthropogenic activity. The physical form of copper is important in considering its behavior in the environment and availability to biota. Most copper in soils is in mineral form or bound tightly to organic matter. Copper deposited in soil will strongly adsorb and remain in the upper few centimeters. Alkaline conditions in soil and water favor precipitation of copper, which may cause deficiencies in plants. Conversely, acid conditions promote solubility and therefore mobility of copper (2). Lower pH concentrate the free ions available and cause copper toxicity at a cellular level, therefore at lower pH levels, bioavailability of copper is increased (7).

Studies have not shown evidence of copper bioaccumulation in the food chain, but disruption of the food chain can be hypothesized. A Bioconcentration Factor (BCF) of 10 has been determined for copper (1). Copper can disrupt important microbial processes in soils, such as nutrient cycling. Certain plant species (lichens and mosses) are especially sensitive to copper and can be eliminated from the ecosystem. Some plants accumulate copper at high levels, with low-growing grasses generally having the highest concentrations and tree foliage the lowest.

Table J-45
(Continued)

Aside for the potential decrease in food supply, there has been little documentation of effects of copper on wildlife, however, effects on domestic animals have been reported (4). It is well recognized that sheep are especially sensitive to toxicity due to copper. In ruminants, dietary levels of other trace elements, such as zinc, affect the toxicity of copper. An antagonism between copper and molybdenum has long been recognized in ruminants. High levels of molybdenum in feed stuff may protect sheep exposed to high levels of copper or may precipitate copper deficiency in animals exposed to marginal levels of dietary copper (3). Molybdenum is used therapeutically in cases of copper toxicosis (2). Toxic effects of copper seen in sheep when copper levels reach 150 ppm (wet-weight) in the liver usually is mortality in > 75% of sheep tested (5). Overt manifestations of copper toxicosis in ruminants are secondary to a hemolytic crisis triggered by severely elevated copper levels. Copper levels below 1 ppm in waters inhabited by fish are toxic. Chronic dietary copper levels of 26-38 ppm for sheep can markedly elevate hepatic copper levels, whereas levels of 500 ppm copper in rat diets are well tolerated (2).

References:

1. Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for Copper. 1989.
2. Mineral Tolerance of Domestic Animals. National Academy of Sciences Washington D.C. 1980.
3. Health Effects Assessment for Copper. USEPA 540/1-86/025 Sept 1984.
4. Summary Review of the Health Effects Associated with Copper: Health Issue Assessment. EPA 600/8-87/001, February 1987.
5. Medical & Biological Effects of Environmental Pollutants, Copper. National Academy of Sciences Washington D.C. 1977
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Table J-46
Ecological Toxicity Profile for Dibenz(a,h)anthracene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Dibenz(a,h)anthracene						
Mouse		Oral	Acute	Death	TD_{LO} = 4,160 mg/kg	1
Rat	200 mg/kg	Oral	Acute	Oncogenic trans-formation		2
Rat		Subcutaneous	Acute	Tumorigenic	TD_{LO} = 2.4 mg/kg	3
Mouse		Subcutaneous	Acute	Tumors at site of injection	TD_{LO} = 0.445 mg/kg	4
Guinea pig		Intervaneous	Acute	Tumors; lung and thorax	TD_{LO} = 30 mg/kg	5
Rat	3 mg/Kg	Interperitoneal	Acute	Reduced growth rate		6
Rat	5 mg/day	Subcutaneous	GD 1 to birth	Fetal resorption and death		7
Rat	0.76 - 0.85 mg/day	Oral	Chronic	Pulmonary adenomas		8
Mouse		Subcutaneous	Acute (single injection)	Local sarcomas	LOAEL = 0.0019 mg	7
Mouse	0.012 mg/kg/day	Dermal application	Lifetime	Papilloma carcinoma		7
Rodent	0.006 mg/kg	Oral	Chronic	Carcinogenic		9
Frog		Injection into kidney		Renal adenosarcomas	TD_{LO} = 12 mg/kg	10
Pigeon		Intramuscular Injection		Fibrosarcomas at site of injection (12 %)	TD_{LO} = 6 mg/kg	11
Fowl	0.4 % in lard	Intramuscular injection		Sarcomas (48 %)		12

Table J-46
(Continued)

Dibenz(a,h)anthracene [D(ah)A] is a polycyclic aromatic hydrocarbon (PAH) that is a byproduct of incomplete combustion. In the environment, D(ah)A adsorbs strongly to soil and sediment (K_{ow}=6.9x10^6, K_{oc}=3.3x10^6). It is considered immobile in soil and leaching to groundwater is not expected. The major fate of soil and sediment-bound D(ah)A is biodegradation. The $T_{1/2}$ in soil is estimated to be approximately 18 - 21 days. Limited lethality, systemic or reproductive toxicity data is available for D(ah)A. D(ah)A has been shown to be carcinogenic in experimental animals (lung, thorax and skin). There is sufficient evidence that D(ah)A is active in short-term gentoxicity tests.

References:

1. Sax's Dangerous Properties of Industrial Materials, Richard J. Lewis, 8th ed.
2. Cancer Res, Vol 38 pg 2621 (1978).
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6. Int. Agency for Research on Cancer, V32, 301 (1983).
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11. J Natl Cancer Inst, vol 32 pg 905, (1964).
12. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man V3 186 (1973).

Table J-47
Ecological Toxicity Profile for Dibromomethane

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Dibromomethane						

Environmental Fate:

- Log K_{ow} = 1.23 (1)

Bioconcentration Factor (BCF):

- Fish, BCF = 5 (1)

References:

1. Sims and Hansen, Soil, Transport, and Fate Database, Version 2.0, Utah State University, April 1991.

Table J-48
Ecological Toxicity Profile for Dieldrin

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Dieldrin						
Rat		Oil-gavage	One time	Death	LD_{50} = 168 mg/kg/day for newborn	1
Rat		Oil-gavage	One time	Death	LD_{50} = 37 mg/kg/day for young adult	1
Mouse		Oral-food	2 weeks	Impaired antigen processing	LOAEL = 0.065 mg/kg/day	1
Rat		Oil-gavage	10 days, once per day; GD 7-16	Maternal mortality	LOAEL = 6 mg/kg/day	1
Mouse		Oral-food	74 days	Increased mortality	LOAEL = 2.6 mg/kg/day	1
Mouse		Oral-food	74 days	Increased pup mortality	LOAEL = 0.65 mg/kg/day	1
Mouse		Oral-food	74 days	Decreased fertility	LOAEL = 1.3 mg/kg/day	1
Mouse		Oral-food	120 days	Decreased litter size	LOAEL = 0.65 mg/kg/day	1
Bald eagle		Trophic	Lifetime	Successful reproduction	NOEL = 0.3 mg/kg of egg	2
Mallard ducklings		Oral-food	24 days	Growth impairment	NOEL = 0.3 mg/kg	5
Freshwater aquatic organism			Chronic	Protection of aquatic life	AWQC = 0.0019 ug/L	9
Saltwater aquatic organism			Chronic	Protection of aquatic life	AWQC = 0.0019 ug/L	9
Fulvous whistling duck				Death	LD_{50} = 100-200 mg/kg	8

Table J-48
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Dieldrin						
Mallard				Death	LD_{50} = 381 mg/kg	8
California quail				Death	LD_{50} = 8.78 mg/kg	8
Japanese quail				Death	LD_{50} = 69.7 mg/kg	8
Pheasant				Death	LD_{50} = 79.0 mg/kg	8
Gray partridge				Death	LD_{50} = 8.84 mg/kg	8
Rock dove				Death	LD_{50} = 26.6 mg/kg	8
House sparrow				Death	LD_{50} = 47.6 mg/kg	8
Mule deer				Death	LD_{50} = 75-150 mg/kg	8
Domestic goat				Death	LD_{50} = 100-200 mg/kg	8
Rainbow trout				Death	LC_{50} = 0.0025 mg/L	5
Mallard				Death	LD_{50} = 381 mg/kg	6
Amphipod (*H. azteca*)		Medium	10 days	Death	LC_{50} = 7.6 μg/L	7
Chironomid (*C. tentans*)		Medium	10 days	Death	LC_{50} = 1.1 μg/L	7
Meadow vole					NOAEL = 0.04 mg/kg/day	10
Red fox					NOAEL = 0.009 mg/kg/day	10
American robin					NOAEL = 0.139 mg/kg/day	10

Table J-48
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Dieldrin						
Great blue heron					NOAEL = 0.045 mg/kg/day	10
Cooper's hawk					NOAEL = 0.079 mg/kg/day	10
Red-tailed hawk					NOAEL = 0.058 mg/kg/day	10
Aldrin						
Rat		Oil-gavage	One time	Death	LD_{50} = 39 mg/kg/day for males; LD_{50} = 60 mg/kg/ day for females	1
Fulvous whistling duck				Death	LD_{50} = 89.2 mg/kg	8
Mallard				Death	LD_{50} = 520 mg/kg	8
Bobwhite				Death	LD_{50} = 6.59 mg/kg	8
Pheasant				Death	LD_{50} = 16.8 mg/kg	8
Mule Deer				Death	LD_{50} = 18.8 mg/kg	8
Hamster		Oil-gavage	One time at GD 7, 8 or 9	Increased fetal mortality	LOAEL = 50 mg/kg/day	1
Mouse		Gavage	5 days, one time/day	Decreased male fertility	LOAEL = 0.5 mg/kg/day	1
Rat		Oral-food	31 months	Decreased lifespan in females	LOAEL = 2.5 mg/kg/day	1
Rat		Oral-food	2 years	Increased mortality	LOAEL = 5 mg/kg/day	1
Meadow vole					NOAEL = 0.396 mg/kg/day	10
Red fox					NOAEL = 0.086 mg/kg/day	10

Table J-48
(Continued)

In 1970, the U.S. Department of Agriculture canceled all uses of dieldrin and aldrin based on the concern that these chemicals could cause severe aquatic environmental changes and potentiall carcinogenicity. Aldrin is readily converted to dieldrin by epoxidation in all aerobic and biologically active soils. Dieldrin persists because it is more resistant to biotransformation and abiotic degradation than aldrin. Transport of aldrin and dieldrin in soils is minimal because these compounds tend to bind tightly to soil, however, they both can volatilize from soil. Aldrin undergoes photolysis to dieldrin, which in turn may be degraded by ultraviolet radiation or microbial action into the more persistent photodieldrin. The logarithm of the n-octanol/water partition coefficient (log K_{ow}) for aldrin ranges from 5.68 to 7.4 and for dieldrin ranges from 4.32 to 6.2 indicating a high potential for bioaccumulation. Dieldrin is extremely nonpolar and therefore has a strong affinity for organic matter such as animal fat and plant waxes; it also sorbs tightly to soil particles. Dieldrin bioconcentrates and biomagnifies through the terrestrial and aquatic food chains.

Exposure to aldrin is limited because aldrin is broken down very quickly to dieldrin in the environment (1). The acute lethal dose for aldrin ranges from 20-70 mg/L. The lowest dietary levels that resulted in some mortality in short-term or chronic feeding studies in common mammalian species were: mice (10 ppm), dogs (10 ppm), and rabbits (80 ppm). Increased liver/body ratio and histological changes in the liver were the most sensitive effect criteria noted (3). Decreased survival in animals consuming aldrin and/or dieldrin over long periods of time was seen at low doses. Dogs and mice appear to have a sensitivity to the chronic lethal effects of aldrin and/or dieldrin that is similar to that of rats. Decreased survival in dogs exposed for 25 months was observed at 1 mg/kg/day aldrin or 0.5 mg/kg/day of dieldrin (1). 2.5 mg/kg of dieldrin fed to rats produced an increased liver size in both sexes. The same dietary level reduced the number of pregnancies, influenced the numbers of young/litter and slightly reduced survival times of the litters (4). Dieldrin has been identified as a cause of death for several species of birds, including bald eagles, in the Chesapeake Bay region. An estimated 15% of the barn owl population nesting in offshore duck blinds on the Maryland side of the lower Potomac River in 1972 and 1973 contained levels of organochlorines, mostly DDE and dieldrin, which may have been high enough to harm their reproduction (2).

Bioaccumulation Factors (BAF):
Dieldren (60-57-1)

Earthworm = 8 (11)

Bioconcentration Factors (BCF):

Dieldrin (60-57-1):
- Fish = 6145
- Algae = 7480
- Crabs = 247
- Clams = 1015
- Water plant (*Elodea*) = 1280
- Snails = 114,935
- Ciliate (*Tetrahymena pyriformis*) = 2095

Aldrin (309-00-2):
- Fish = 3140
- Snails = 44,600

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Table J-49
Ecological Toxicity Profile for Dioxin-like Compounds

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Dioxin-like Compounds						
Guinea pigs		Oral as 2,3,7,8-TCDD	90 day	Death	LD_{50} = 0.008 µg/kg/day	1
Monkeys		Oral as 2,3,7,8-TCDD	9 months	Death (50%)	LD_{50} = 0.01 µg/kg/day	1
Rats		Oral as 2,3,7,8-TCDD	2 years	Toxic hepatitis leading to death	LOAEL = 0.001 µg/kg/day	1
Monkeys		Oral as 2,3,7,8-TCDD	7 months	Spontaneous abortions (66%)	LOAEL = 0.001 µg/kg/day	1
Rabbits		Dermal as 2,3,7,8-TCDD	1 day 1 time	Death	LD_{50} = 275 µg/kg	1
Guinea pigs		Oral as 2,3,7,8-TCDD	1 day 1 time	Death	LD_{50} = 0.6 µg/kg	1
Rat		Oral - food as 2,3,4,7,8-PCDF	13 weeks	Death	LOAEL = 10 µg/kg/day	3
Monkey		Oral - food as TCDF	6 months	Death	LOAEL = 0.21 µg/kg/day	3
Rat		Oral - food as 2,3,4,7,8-PCDF	13 weeks	Body weight loss	LOAEL = 10 µg/kg/day	3
Rat		Oral - food as CDF mixture	4 weeks	Decreased seminal vesical weight, reduced testosterone	LOAEL = 960 µg/kg/day	3
Domestic chicken	4.5 ng/egg			Death (100%mortality)		7
Domestic chicken	1.8 ng/egg			Death (80% mortality)		7

Table J-49
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Dioxin-like Compounds						
Mallard		2,3,7,8-TCDD		Death	LD_{50} > 0.108 mg/kg	4
Bobwhite		2,3,7,8-TCDD		Death	LD_{50} = 0.015 mg/kg	4
Ringed turtle dove		2,3,7,8-TCDD		Death	LD_{50} > 0.810 mg/kg	4
Freshwater aquatic organism		2,3,7,8-TCDD	Chronic	Proposed AWQC - protection of aquatic life	LOEL <0.00001 μg/L	8
Northern Pike (*Esox lucius*)	0.1 ug/L	Medium as 2,3,7,8-TCDD	96 hours	Growth retardation		5
Mosquitofish	2.4-4.2 ug/L	Medium as 2,3,7,8-TCDD	15 days	Death		5
Chicken		2,3,7,8-TCDD		Death	LD_{50} = 25-50 μg/kg	5
Dog		2,3,7,8-TCDD			LD_{50} = 100-200 μg/kg/day	5
Meadow vole		1,2,3,6,7,8-HxCDF			NOAEL = 0.00032 mg/kg/day	9
Red fox		1,2,3,6,7,8-HxCDF			NOAEL = 0.00007 mg/kg/day	9

Polychlorinated dibenzodioxins (CDDs) and polychlorinated dibenzofurans (CDFs) are chemically classified as halogenated aromatic hydrocarbons. The chlorinated dibenzodioxins and dibenzofurnas are tricyclic aromatic compounds with similar physical and chemical properties, and both classes are quite similar structurally. There are 75 possible different positional congeners of CDDs and 135 different CDF congeners. CDDs and CDFs can be formed as unintentional by-products through a variety of chemical reactions and combustion processes. TCDD is an undesirable contaminant of the pesticide 2,4,5-T and trichlorophenol (4). In general, these compounds have low water solubility, high K_{ow}s, low vapor pressure and tend to bioaccumulate. Because of their low water solubilities and vapor pressures, CDDs and CDFs located below the soil surface (i.e., below the top few millimeters) are strongly adsorbed and show little upward or downward migration, particularly in soils with high organic carbon (2).CDDs are bioconcentrated in aquatic organisms and terrestrial animals, but the magnitude of bioconcentration is lower than expected from predictive methods (e.g. Kow). This is due to the fact that some of these compounds are metabolized in aquatic and terrestrial animals (3). Bioaccumulation of CDDs in plants from soils is expected to be small. There is no evidence of biomagnification of PCDDs in birds, but it is speculated that piscivorus birds have a greater potential to accumulate PCDDs than the fish that they eat (5).

Table J-49
(Continued)

2,3,7,8-Tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD)
CAS No. 1746-01-6

- Log K_{ow} = 6.15 - 7.28
- Log K_{oc} = 6.0 - 7.39
- Vapor pressure at 25°C = 1.52×10^{-9} mmHg
- Henry's law constant = 8.1×10^{-5} atm-m^3/moL at 25°C(1).
- Water solubility = 1.93×10^{-5} mg/L at 22°C(2)
- Mosquito fish BCF = 1482
- Molluscs BCF = 3731 (5)
- Earthworms BAF = 5 (10)
- Earthworm BCF = 14.5 (6)

Pentachlorodibenzo-p-dioxin (1,2,3,7,8-PeCDD)
CAS No. 40321-76-4

- Log K_{ow} = 6.64
- Vapor pressure = 9.48×10^{-10} mmHg at 25°C

Hexachlorodibenzo-p-dioxin (1,2,3,4,7,8-HxCDD)
CAS No. 39227-28-6

- Log K_{ow} = 7.79
- Log K_{oc} = 5.92
- Vapor pressure = 1.0×10^{-10} mmHg at 25°C
- Henry's law constant = 1.2×10^{-5} atm-m^3/moL at 25°C
- Water solubility = 4.40×10^{-6} mg/L at 20°C(2)

Heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-HpCDD)
CAS No. 35822-46-9

- Log K_{ow} = 8.20
- Vapor pressure = 3.21×10^{-11} mmHg at 25°C
- Henry's law constant = 7.5×10^{-6} atm-m^3/moL at 25°C.
- Water solubility = 2.4×10^{-6} mg/L at 20°C(2)

Octochlorodibenzo-p-dioxin (1,2,3,4,6,7,8,9-OCDD)
CAS No. 3268-87-9

- Log K_{ow} = 7.59
- Vapor pressure = 8.25×10^{-13} mmHg
- Henry's law constant = 7.0×10^{-9} atm-m^3/moL at 25°C.
- Water solubility = 7.4×10^{-8} mg/L at 25°C(2)

Tetrachlorodibenzofuran (2,3,7,8-TCDF)
CAS No. 51207-31-9

- Log K_{ow} = 6.53
- Vapor pressure = 8.96×10^{-9} mmHg

Table J-49
(Continued)

- Henry's law constant = 8.6×10^{-6} atm-m^3/moL at 25°C.
- Water solubility = 4.19×10^{-4} mg/L at 22.7°C(2)

Pentachlorodibenzofuran (1,2,3,7,8-PeCDF)
CAS No. 57117-41-6

- Log K_{ow} = 6.79
- Vapor pressure = 2.72×10^{-9} mmHg at 25°C
- Guppy BCF = 2,400 (3)

Hexachlorodibenzofuran (1,2,3,4,7,8-HxCDF)
CAS No. 70648-26-9

- Vapor pressure = 2.4×10^{-10} mmHg
- Henry's law constant = 1.4×10^{-5} atm-m^3/moL at 25°C
- Water solubility = 8.25×10^{-6} mg/L at 22.7°C(2)

Heptachlorodibenzofuran (1,2,3,7,8-HpCDF)
CAS No. 67562-39-4

- Log K_{ow} = 7.92
- Vapor pressure = 1.33×10^{-10} mmHg at 25°C
- Henry's law constant = 5.3×10^{-5} atm-m^3/moL at 25°C.
- Water solubility = 1.35×10^{-6} mg/L at 22.7°C(2)

Octachlorodibenzofuran (1,2,3,4,6,7,8,9-OCDF)
CAS No. 39001-02-0

- Log K_{ow} = 8.78
- Vapor pressure = 3.75×10^{-12} mmHg at 25°C
- Henry's law constant = 1.9×10^{-6} atm-m^3/moL at 25°C
- Water solubility = 1.2×10^{-6} mg/L at 25°C(2)
- Guppy BCF = 589 (3)

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Table J-50
Ecological Toxicity Profile for Di-n-Butylphthalate (DBP)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Di-n-Butylphthalate (DBP)						
Rat		Gavage	Single dose	2/10 deaths	LOAEL = 10 g/Kg	1
Rat		Gavage	Single dose	4/9 deaths	LOAEL = 8 g/Kg	1
Mouse		Gavage	1/day, gestation days 6-13	No viable litters	LD_{10} = 2.5 g/Kg	1
Rat		Oral	7 days	Decreased spermatocytes, testes weight	LOAEL = 1,000 mg/Kg/day	1
Guinea Pig		Oral	1/day, 7 days	Severe testicular lesions	LOAEL = 2,000 mg/Kg/day	1
Rat		Oral	52 weeks	Death	LOAEL = 625 mg/Kg	1
Rat		Oral	48 days, including gestation and lactation	Decreased pup weight	LOAEL = 125 mg/Kg	1
Ring doves (*Streptopelia risoria*)	10 ppm	Oral - diet		Reduced eggshell thickness		2
Rainbow trout			Medium	96 hour flow-through	LC_{50} = 1.8 mg/L	2
Fathead minnow			Medium	96 hour flow-through	LC_{50} = 0.92 mg/L	2

Di-n-butylphthalate (DBP) is a plasticizer used in epoxy resins and polyvinyl chloride production. DBP adsorbs moderately to soils (log K_{ow}=5.60, log K_{oc}=5.23). Biodegradation from soils is expected to be slow while biodegradation from aquatic systems is expected to be rapid. DBP has a relatively low acute toxicity in animals. Oral exposure studies have provided evidence of the ability of DBP to produce testicular damage in experimental animals. Toxic effects have also been demonstrated in female reproductive abilities. DBP has been shown to be toxic to fetuses in several animal studies. Limited experimental data suggests teratogenic activity.

References:
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Table J-51
Ecological Toxicity Profile for Endosulfan, Endosulfan I, and Endosulfan Sulfate

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Endosulfan, Endosulfan I, II and Endosulfan Sulfate						
Rat		Gavage-oil	One time	Death	LD_{50} = 121 mg/kg/day	1
Rat		Gavage-oil	7 days	Increased liver weight	LOAEL = 2.5 mg/kg/day	1
Rat		Gavage-oil	7-15 days	Decreased testosterone levels	LOAEL = 5 mg/kg/day	1
Rat		Oral-food	84 days	Decreased litter weight	LOAEL = 3.75 mg/kg/day	1
Mouse		Oral-food	78 weeks	Testicular atrophy (males), ovarian cysts (females)	LOAEL (males) = 0.46 mg/kg/day, (females) = 0.26 mg/kg/day	1
Rainbow trout		Medium	96 hour static	Death	LC_{50} = 1.6 µg/L	2
Freshwater aquatic organism		All isomers	Chronic	Protection of aquatic life	AWQC = 0.0056 ug/L	8
Freshwater fish (*Channa puncutata*)		Medium	96 hour		LC_{50} = 0.16 ppb (Endosulfan I) LC_{50} = 4.8 ppb (tech) LC_{50} = 6.6 ppb (Endosulfan II)	
Carp (*Cirrhinus mrigrala*)			96 hour		LC_{50} = 0.6 ppb (Endosulfan I) LC_{50} = 1.3 ppb (tech) LC_{50} = 8.8 ppb (Endosulfan II)	
Saltwater aquatic organism		All isomers	Chronic	Protection of aquatic life	AWQC = 0.0087 ug/L	8
Japanese quail		Egg immersed 30 sec.	Observed 15-17 days	Embryonic mortality	0.1 g/L	5
Mallard		Oral		Acute	LD_{50} = 205-245 mg/kg	4

Table J-51
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Endosulfan, Endosulfan I, II and Endosulfan Sulfate						
Ring-necked pheasant		Oral		Acute	LD_{50} = 620-1,000 mg/kg	4
Meadow vole		Endosulfan			NOAEL = 0.29 mg/kg/day	9
Red fox		Endosulfan			NOAEL = 0.065 mg/kg/day	9
American Robin		Endosulfan			NOAEL = 17.22 mg/kg/day	9
Great Blue Heron		Endosulfan			NOAEL = 5.54 mg/kg/day	9
Cooper's hawk		Endosulfan			NOAEL = 9.69 mg/kg/day	9
Red-tailed hawk		Endosulfan			NOAEL = 7.10 mg/kg/day	9

Endosulfan is registered in the United States and widely used as a contact and stomach insecticide on over 60 food and non-food crops. Pure endosulfan may be found as two different conformations, α or I and β or II. Technical grade endosulfan consists mainly of these isomers as well as a few impuritites and degradation products. One of these products, endosulfan sulfate, which has similar chemical properities to the pure substance, results from endosulfan's photolysis, biotransformation, or oxidation. Both endosulfan isomers can be readily metabolized to endosulfan sulfate by a variety of organisms.

Endosulfan has been released into the environment mainly as a result of its use as an insecticide. There are no known natural sources of the compound. (3). Endosulfan does not bioaccumulate to high levels in terrestrial or aquatic systems. In aquatic systems, residue levels in fish generally peak within 7 days to 2 weeks after continuous exposure to endosulfan. In terrestrial systems, endosulfan generally is not translocated in plant tissues (1). No toxicity information was found for the environmental fate specific to the isomers or Endosulfan Sulfate.

Table J-51
(Continued)

Bioconcentration:
- BCF = < 3,000 for endosulfan.
- BCF = 600, 22.5 in mussels for endosulfan.
- BCF = 2,755 in striped mullet for endosulfan (1).
- Endosulfan does not appear to biomagnify in the food chain.
- BCF = 59 in mosquitofish for Endosulfan I

Environmental Fate:

Endosulfan (CAS 115-29-7)
- Solubility in water at 22°C = 0.16 - 0.15 ppm
- Log K_{ow} = 3.55, 3.62
- Log K_{oc} = 3.5
- Vapor pressure at 25°C = 1×10^{-5} mmHg
- Henry's Law constant at 25°C = 1.0×10^{-5} atm-m^3/moL

Endosulfan I (CAS 959-98-8)
- Solubility in water at 22°C = 0.32 ppm
- Log K_{ow} = 3.83, 3.55
- Vapor pressure at 25°C = 1×10^{-5} mmHg
- Henry's Law constant at 25°C = 1.0×10^{-5} atm-m^3/moL

Endosulfan II (CAS 33213-65-9)
- Solubility in water at 22°C = 0.33 ppm
- Log K_{ow} = 3.52
- Vapor pressure at 25°C = 1×10^{-5} mmHg
- Henry's Law constant at 25°C = 1.91×10^{-5} atm-m^3/moL

Endosulfan Sulfate (CAS 1031-07-8)
- Solubility in water at 22°C = 0.22 ppm
- Log K_{ow} = 3.66
- Vapor pressure at 25°C = 1×10^{-5} mmHg
- Henry's Law constant at 25°C = 2.6×10^{-5} atm-m^3/moL

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Table J-52
Ecological Toxicity Profile for Endrin/Endrin Aldehyde

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Endrin/Endrin Aldehyde						
Rat		Gavage	Single dose	Death	LD_{50} = 5.6 mg/kg/day (male), 5.3 mg/kg/day (female)	1
Hamster		Gavage	GD 5-14	Maternal mortality	LOAEL = 1.5 mg/kg/day	1
Rat		Gavage	GD 7-20	Reduced weight gain	LOAEL = 0.3 mg/kg/day	1
Mouse		Gavage	GD 7-17	Decreased fetal weight	LOAEL = 1 mg/kg/day	1
Hamster	2.5 mg/kg	Oral		Fetal deaths, congenital anomalies, growth retardation		2
Rat	50-100 ppm	Oral-food	2 years	Degenerative liver changes		2
Dog	0.13 mg/kg/day	Food	1-19 months	Liver, kidney lesions		1
American toad			96 hour	Death	LC_{50} = 10 ppb	3
Mallard					LD_{50} = 5.64 mg/kg	4
Sharp tailed grouse					LD_{50} = 1.06 mg/kg	4
Pheasant					LD_{50} = 1.78 mg/kg	4
Mule deer					LD_{50} = 6.25 - 12.5 mg/kg	4
Goat					LD_{50} = 25.0 - 50.0 mg/kg	4
Freshwater/saltwater aquatic organism			Chronic	Protection of aquatic life	AWQC = 0.0023 ug/L	8
Fathead minnow		Medium	96 hour	Reduction in growth	EC_{50} = 0.5 μg/L	7
Fathead minnow		Medium	96 hour	Death	LC_{50} = 0.7 μg/L	7
Mosquitofish		Medium	48 hour	Death	LC_{50} = 0.6 ppb	6
Meadow Vole					NOAEL = 0.081 mg/kg/day	9

Table J-52
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Endrin/Endrin Aldehyde						
Red Fox					NOAEL = 0.018 mg/kg/day	9
American Robin					NOAEL = 0.73 mg/kg/day	9
Cooper's Hawk					NOAEL = 0.41 mg/kg/day	9
Red-tailed Hawk					NOAEL = 0.302 mg/kg/day	9

Endrin was used as an insecticide, rodenticide and avicide to control cutworms, voles, grasshoppers, borers and other pests on cotton, sugarcane, tobacco, apple orchards and grain. All uses of Endrin in the U.S. were voluntarily canceled by the manufacturer, Velsicol Chemical Company, in 1986. Endrin aldehyde was never a commercial product, but occurred as an impurity of endrin or as a degradation product. Releases of endrin into the soil as the result of agricultural use have been the principal input into the environment. Endrin tightly binds to soil and leachability is small. Endrin is biodegraded in soil by a large spectrum of soil bacteria. It is persistent in water with about 80% of endrin remaining after incubation for 16 weeks.

Endrin is lethal to animals when sufficiently high doses are administered by oral gavage or in the diet. The minimum lethal dose for monkeys (1 to 3 mg/kg) is lower than the minimum lethal doses for cats, rats, rabbits (5 to 7 mg/kg) and male guinea pigs (24 to 36 mg/kg). Meadow and pine mice are susceptible to endrin lethality when exposed in the environment (1). Experimental feeding of endrin to animals has produced abnormalities in offspring (2). Endrin is rapidly metabolized in animals to hydrophilic metabolites which are excreted. Continuous exposure to endrin in diets results in only a limited accumulation in body fat (5). EPA has evaluated the potential carcinogenicity of endrin in animals and determined that no defined potential for cancer exists (1).

Endrin (72-20-8)
- Solubility in water at 25°C = 0.25 mg/L
- Log K_{ow} = 5.338
- Log K_{oc} = 3.230
- Vapor pressure at 25°C = 2.7×10^{-10} mmHg
- Henry's Law Constant = 4.0×10^{-7} atm-m^3/moL
- Endrin BCF (calculated) = 6561

Endrin Aldehyde (7421-93-4)
- Solubility in water at 25° = 50 mg/L
- Log K_{ow} = 3.146
- Log K_{oc} = 2.826
- Vapor pressure at 25°C = 2.0×10^{-7} mmHg
- Henry's Law constant = 2×10^{-9} atm-m^3/moL
- Endrin aldehyde BCF (calculated) = 121

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Table J-53
Ecological Toxicity Profile for Ethylbenzene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Ethylbenzene						
Rat	408 - 680 mg/kg/day	Oral	182 days	Increased liver and kidney weight		1
Rat		Oral	Single dose	Death	LD_{50} = 3,500 mg/kg	3
Rat		Inhalation	7 hrs	Fetotoxicity	TC_{Lo} = 985 ppm	4
Rat		Inhalation	7 hrs	Decreased fertility	TC_{Lo} = 97 ppm	4
Rabbit		Inhalation	7 hrs	Decreased fertility	TC_{Lo} = 99 ppm	4
Rabbit		Inhalation	24 hrs	Fetotoxicity	TC_{Lo} = 500 mg/m^3	4
Fish		Oral	96 hr	Death	LC_{50} = 42.3 - 48.5 mg/L	2
Shrimp (*Mysidopsis bahia*)		Medium	96 hr	Death	LC_{50} =275 mg/L	7
Guppy (*Poecilla reticulata*)		Medium	96 hr	Death	LC_{50} =97.1 mg/L	8
Fathead minnow (*Pimephales promelas*)		Medium - static	96 hr	Death	LC_{50} =42.3 mg/L	9
Coho salmon (*Oncorhynchus kisutch*)		Medium - static	24 hr	Death	LC_{100} =50.0 mg/L	9

Table J-53
(Continued)

Ethylbenzene is an aromatic hydrocarbon present in crude petroleum. The physicochemical properties of ethylbenzene reveal a strong tendency for it to partition to the atmosphere. Sorption and retardation by soil organic carbon will occur to a small extent, but sorption is not significant enough to prevent migration in most soils. Ethylbenzene does not significantly bioaccumulate. A BCF in fish of 37.5 based on its log Kow has been estimated. Biodegradation of this compound occurs by aerobic soil microbes. In surface water, transformation may occur through oxidation and biodegradation (5).

Bioconcentration:
- Goldfish, log BCF = 1.9
- Clams, log BCF = 0.67
- Fish, log BCF = 2.16
- Clam, BCF = 4.7 (6)

Environmental fate:
- Log K_{ow} = 3.15, good probability of adsorption to soil
- Henry's Law constant 8.44 x 10-3 atm m^3/mole
- Vapor Pressure at 20°C = 7 mmHg

References:

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3. AMA Arch Ind Health, vol 14, pg 387,1956.
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6. EPA Health Effects Assessment for Ethylbenzene. EPA/540/1-86/008. 1984.
7. Hazardous Substance Data Base (HSDB). On-line Computer Database. U.S. Department of Health and Human Services, Bethesda, Md. 1995.
8. Aquatic Information Retrieval (AQUIRE). On-line Computer Database. Chemical Information Systems, Inc., Baltimore, Md. 1995.

Table J-54
Ecological Toxicity Profile for Fluoranthene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Fluoranthene						
Rat		Oral	Not specified	Death	LD_{50} = 2,000 mg/kg	1
Mouse		Interveneous injection	Not specified	Death	LD_{50} = 2 gm/kg	1
Mouse	3.5 mg/mouse	Not specified	Not specified	Increase in lung tumor incidence	Not Specified	2
Rabbit		Dermal	Not specified	Death	LD_{50} = 3.18 gm/kg/24 hr	3
Bluegill		Medium	96 hour	Death	LC_{50} = 3,980 ug/L	4
Sheepshead minnow		Medium	96 hour	Death	LC_{50} = 560 mg/L	4
Mysid shrimp		Medium - static	96 hour	Death	LC_{50} = 40 ug/L	5
Polychaete		Medium - static	96 hour	Death	LC_{50} = 500 mg/L	5
Alga (*Skeletonima costatum*)		Medium - static	96 hour	reduced cell numbers	EC_{50} = 45 mg/L	5

Fluoranthrene is a polycyclic aromatic hydrocarbon (PAH) that is a byproduct of incomplete combustion. In the environment, fluoranthrene adsorbs strongly to soil and would be expected to remain bound in the upper layers of soil (K_{ow} = 7.9x10^4, K_{oc} = 3.8x10^3). Fluoranthene degrades slowly in soil ($t_{1/2}$=5 months - 2 years). The bioconcentration factor as determined in rainbow trout indicates the potential for bioconcentration in aquatic species (Log BCF = 2.58). Limited toxicity data is available for fluoanthrene.

Bioaccumulation Factor (BAF):
- Earthworm = 0.08 (6)

Bioconcentration Factor (BCF):
- Rainbow trout (liver) = 37\

References:

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4. U.S. EPA Ambient Water Quality Criteria Doc.; Fluoranthrene (1980).
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6. Beyer, W.N. Evaluating Soil Contamination. U.S. Fish and Wildl. Serv., Biol. Rep. 90(2). 25 pp., 1990.

Table J-55
Ecological Toxicity Profile for Fluorene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Fluorene						
Grass shrimp (*Palaemonetes pugio*)		Medium	96 hour	Death	LC_{50} = 320 ug/L	3
Bluegill		Medium	30 day	Death	LC_{50} = 500 ug/L	3
Rainbow trout		Medium	96 hour	Death	LC_{50} = 820 ug/L	3
Sandworm		Medium	96 hour	Death	LC_{50} = 1000 ug/L	3
Mayfly (*Hexagenia bileneata*)		Medium	120 hour	Death	LC_{50} = 5800 ug/L	3
Rat	8.6 mg/kg/day	Oral	6 Months	Squamous cell carcinomas, kidney and uterus		1
Mouse		Intraperitoneal injection		Death	LD_{50} = 2 gm/kg	2
Earthworm (*Eisenia foetida*)		Medium-Artificial soil	2 weeks		LC_{50} = 173 ppm	4

Fluorene is a polycyclic aromatic hydrocarbon (PAH) that is a byproduct of incomplete combustion. In the environment, fluorene adsorbs strongly to soil and sediment (K_{ow}=1.5x10^4, K_{oc}=7.3x10^3) and is considered essentially immobile in soil. Biodegradation is a major route of removal in soils ($t_{1/2}$=2 - 64 days). The bioconcentration factor as determined in flathead minnows indicates the potential for bioconcentration (Log BCF 3.7). Limited toxicity data is available for fluorene.

Bioconcentration Factor (BCF):
- Bluegill (30 days) = 200-1800

References:

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4. Beyer, W.N. Evaluating Soil Contamination. U.S. Fish and Wildl. Serv., Biol. Rep. 90(2). 25 pp., 1990.

Table J-56
Ecological Toxicity Profile for Heptachlor and Heptachlor Epoxide

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Heptachlor and Heptachlor Epoxide						
Rat		Oral-food	60 days	16% Embryo survival in F1 generation	LOAEL = 0.25 mg/kg/day	1
Rat		Oral-food	60 days	Fertility decreased by 22% in F1 generation; 100% infertility in F2 generation	LOAEL = 0.25 mg/kg/day	1
Mouse		Oral-food	10 weeks, 4 times/day	100% Infertility	LOAEL = 6.5 mg/kg/day	1
Rat		Oral-food	80 weeks, once/day	20% Decrease in survival of females	LOAEL = 2.56 mg/kg/day	1
Rat		Oral-food	18 months, once/day	24% Decrease in litter size, 57.2% mortality at 1 month	LOAEL = 6 mg/kg/day	1
Mouse		Oral-food	90-91 weeks, once/day	Hepatocellular carcinoma in males	LOAEL = 1.8 mg/kg/day for males and 2.3 mg/kg/day for females	1
Mallard					LD_{50} > 2080 mg/kg	2
American kestrel		Trophic	Lifetime as heptachlor epoxide	Production adversely affected	> 1.5 mg/kg in egg	3
Canada geese		Trophic	Lifetime as heptachlor epoxide	Reduction in hatching success	> 10 mg/kg in egg	3
Mink (*Mustela vison*)		Oral-diet		Reduced kit growth	LOAEL = 6.25 mg/kg	4
Freshwater aquatic organism			Chronic - heptachlor and heptachlor epoxide	Protection of aquatic life	AWQC = 0.0038ug/L	5

Table J-56
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Heptachlor and Heptachlor Epoxide						
Saltwater aquatic organism			Chronic - heptachlor and heptachlor epoxide	Protection of aquatic life	AWQC = 0.0036ug/L	5
Meadow vole			Heptachlor		NOAEL = 1.58 mg/kg/day	6
Red fox			Heptachlor		NOAEL = 0.344 mg/kg/day	6
Snail (*Aplexa hypnorum*)		Medium	96 hours as heptachlor	Death	LC_{50} = 1450 μg/L	7
Bobwhite quail		Oral - diet	5 days as heptachlor	Death	LD_{50} =92 ppm	7
Ring-necked pheasant		Oral - diet	5 days as heptachlor	Death	LD_{50} =224 ppm	7
Daphids		Medium - static	48 hours as heptachlor		EC_{50} = 47 μg/L	7
Stoneflies (*Pteronarcus californica*)		Medium - static	96 hours as heptachlor	Death	LC_{50} =1.1μg/L	7
Northern pike (*Esox lucius*)		Medium - static	96 hours as heptachlor	Death	LC_{50} =6.2 μg/L	7
Alga (*Selenastrum capricornutum*)			96 hours as heptachlor	Growth inhibition	EC_{50} = 26.7 μg/L	7
Fowler's Toad (larvae)			96 hours as heptachlor	Death	LC_{50} =440 μg/L	7
Channel catfish (*Ictalurus punctatus*)		Medium - static	96 hours as heptachlor	Death	LC_{50} =25 μg/L	7

Table J-56
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Heptachlor and Heptachlor Epoxide						
Sheepshead minnow (*Cyprinodon Variegatus*)		Medium (saltwater), flow-through	96 hours as heptachlor	Death	LC_{50} =10.5 μg/L	7

Heptachlor is a man-made chemical that was used for killing insects in homes, buildings and on food crops. There are no natural sources of heptachlor or heptachlor epoxide. Heptachlor and heptachlor epoxide are described together because 20% of heptachlor is changed within hours into heptachlor epoxide in the environment and in living systems such as animals or humans by microsomal enzymes.

The log soil organic carbon adsorption coefficient (log K_{oc}) for heptachlor is estimated to be 4.34. The log K_{oc} for heptachlor epoxide is estimated to range between 3.34 and 4.37. These log K_{oc} values indicate a very high sorption tendency, suggesting these compounds will adsorb strongly to soil and are not likely to leach into groundwater in most cases. The organic matter content of the soil is another factor affecting mobility. Heptachlor and heptachlor epoxide are less likely to leach from soil with a high organic matter content. If released into water they will adsorb strongly to suspended and bottom sediment. Heptachlor and heptachlor epoxide are taken up by plants through the roots. The logarithm of the n-octanol/water partition coefficient (log K_{ow}) for heptachlor is 5.44 and for heptachlor epoxide is 5.40 indicating a high potential for bioconcentration and biomagnification in the food chain. A bioconcentration factor (BCF) of 20 has been calculated. A bioaccumulation factor (BAF) for earthworms for heptachlor epoxide has been calculated to be 10 (8). Heptachlor epoxide is more harmful than heptachlor, primarily because of its ability to be stored in fat for long periods of time. Biomagnification of heptachlor is not significant since heptachlor is metabolized to heptachlor epoxide readily by higher trophic levels. Because of the more persistent nature of heptachlor epoxide and its lipophilicity, biomagnification of heptachlor epoxide in terrestrial food chains is significant.

Animals that ingested heptachlor in food before and/or during gestation had smaller litters, some offspring had damaged eyes, and some offspring did not survive long after birth. Infertility was also observed in studies with rats and mice. Lifetime exposure to heptachlor resulted in liver tumors (1). Heptachlor epoxide does not thin American kestrel eggs. These findings are in agreement with earlier studies of Canada geese. However, the presence of heptachlor epoxide in kestrel eggs indicates food chain contamination (3).

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Heptachlor/Heptachlor epoxide. 1991.
2. Hudson, R.H., Tucker, R.K., and M.A. Haegele. Handbook of Toxicity of Pesticides to Wildlife, second edition. U.S. Dept. of the Interior, Fish and Wildlife Service. Resource Publication 153, Washington D.C. 1984.
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Table J-57
Ecological Toxicity Profile for Indeno(1,2,3-cd)pyrene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Indeno(1,2,3-cd)pyrene						
Mouse		Skin	20 Days	Tumors	TD_{LO} = 40 mg/kg	1
Mice	0.6 mg	Subcutaneous	1 time per month for 265 days	Sarcomas		2
Rat	4.15 mg/kg	Implant		Tumors; lung and thorax		3
Rodent	72 mg/kg-BW	Oral	Chronic	Carcinogen		4

Indeno(1,2,3-CD)pyrene [I(1,2,3-CD)P] is a polycyclic aromatic hydrocarbon (PAH) that is a byproduct of incomplete combustion. In environment, I(1,2,3-CD)P adsorbs strongly to soil and sediment (K_{ow}=3.2x10^6, K_{oc}=1.6x10^6). Lethality, systemic and reproductive toxicity data for I(1,2,3-CD)P is limited. Experimental evidence suggests that I(1,2,3-CD)P is carcinogenic to experimental animals via ingestion. Data is inconclusive regarding carcinogenic potential by dermal exposure. Some evidence of genotoxicity is also indicated.

Bioaccumulation Factor (BAF):
- Earthworm = 0.42(5)

References:
1. Carcinogenesis, Vol 7, pg 1761 (1986).
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4. Eisler, R. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, invertebrates: a synoptic review. U.S. Fish Wildl. Serv. Biol. Rep. 85(1.11). 81 pp. 1987.
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Table J-58
Ecological Toxicity Profile for Iron

The predominant source of iron in the atmosphere is through natural processes such as dust created by wind erosion of weathering mineral deposits, volcanic gas and dust, and forest fires. Anthropogenic sources of atmospheric iron include industrial emissions and burning of fossil fuels. Man-made sources of iron may contribute about 28% of the total atmospheric iron (1).

Iron is an essential element. As such, is not usually assessed for risk in baseline risk assessments. Iron, like other essential metals, has the potential to bioconcentrate in organisms. An estimated Bioconcentration Factor (BCF) of 10 was determined based on the bioconcetrations of other essential metals (2).

References:
1. U.S. Environmental Protection Agency, Office of Emergency and Remedial Response. Research and Development Health Effects Assessment for Iron (and Compounds), Final Draft. September, 1984.
2. Casarett and Doull's Toxicology, The Basic Science of Poisons, third edition, Klassen, C.D., Amdur, M.O., and J. Doull (Eds.) Macmillan Publishing Co. New York, 1986.

Table J-59
Ecological Toxicity Profile for Lead

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Lead						
Rat	10 g/kg	Oral-food	2 generations	Decreased pup weights; decreased pups/litter		1
Rat	0,0.5,5,50, 250 mg/L	Oral-water	6-7 weeks pre-breeding until 6-9 months post partum	Decreased maternal BW and delayed sexual maturation of female offspring; delayed locomotor development	LOAEL = 0.5 mg/kg/day	1
Rat	0.7 mg/kg/day	Oral-water	First 18-21 days of gestation	Reproductive toxicity	LOAEL = 0.04 mg/kg/day (female) LOAEL = 0.5 mg/kg/day (male)	2
Mouse	2.2 mg/kg or 3 mg/kg		Daily	Frequency of pregnancy reduced when dose given 3-5 days after mating		3
Mouse	20 mg/kg	Intrauterine	Single dose	Smaller litters; increased fetal deaths		3
Rat	5 mg/L	Oral-water	Lifetime	Reduced survival and longevity		3
Rat	200 mg/kg		Daily	50% of progeny dead in 3 weeks		3
Sheep	8 mg/kg		220 days	Death		3
Horse	2.4 mg/kg	Oral-food	Daily	Death		3
Horse	1.7 mg/kg	Oral-food		Lethal over several months		3
Cattle	6-7 mg/kg		Daily for 2 months	Fatal		3

Table J-59
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Lead						
Cattle	220-400 mg/kg	Oral	Single dose	Fatal		3
Cattle	5 mg/kg		10-20 days	Blindness, 16% mortality		3
Bald eagle		Oral	121 days	20-25% decrease in hematocrit and hemoglobin concentration	0.8 mg/L blood level	4
Mallard	8 mg/kg	Oral-diet as lead nitrate	6 days	66% decrease in erythrocyte count		4
Herring gull, day-old chick	100 mg/kg	Interperitoneal injection	Singel dose	Reduced growth rate, reduced bill and wingbone length		13
Japanese quail	500 mg/kg	Oral-diet as lead acetate	Several weeks	Significant anemia, decreased hemoglobin concentration		4
Fathead minnow		Medium pH = 6-6.5		Death	LC_{50} = 810 ug/L	5
American kestrel	625 ppm 125 mg/kg	Diet		Death (40% mortality) Significant impairment of growth		12
Bald eagle		Trophic		Sub-lethal poisoning	> 0.6 ug/g blood level	6
Freshwater aquatic organsim			Chronic	Protection of aquatic life	AWQC = 3.2 ug/L	14

Table J-59
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Lead						
Saltwater aquatic organism			Chronic	Protection of aquatic life	AWQC = 8.5 ug/L	14
Guppies				Delayed sexual maturity	2 ppm	10
Fathead minnow		Medium	96 hours as $PbCl_3$	Death	LC_{50} = 5.58 ppm	10
Mallard	6-8 mg/kg/day as lead nitrate			Lowered hematocrit and hemoglobin concentration		11
Meadow vole	As lead nitrate				NOAEL = 15.86 mg/kg/day	15
Red fox	As lead nitrate				NOAEL = 3.44 mg/kgday	15
Terrestrial plant		Soil		20% reductino in plant growth	50 mg/kg	15

Lead is ubiquitous and is a characteristic trace constituent in rocks, soils, water, plants, animals and air. More than 4 million metric tons of lead are produced worldwide each year, mostly for the manufacture of storage batteries, gasoline additives, pigments, alloys and ammunition. The widespread broadcasting of lead through anthropogenic activities, especially during the past 40 years, has resulted in an increase in lead residues throughout the environment. Lead is neither essential nor beneficial to living organisms and is toxic in most of its chemical forms. Excessive amounts of lead can cause growth inhibition in plants, as well as reduced photosynthesis, mitosis, and water absorption. In domestic and experimental animals, lead adversely affects weight, survival, behavior, litter size, skeletal development, and induces teratogenic and carcinogenic responses in some species.

Lead chemistry is complex. In water, lead is most soluble and bioavailable under conditions of low pH, low organic content, low concentrations of suspended sediments, and low concentrations of salts of calcium, iron, manganese, zinc and cadmium (3). Models of lead speciation combined with toxicity changes in the cell membrane predict that lead is more toxic at lower pH (4). Likewise for soils, mobility is dependent on factors such as pH, organic content, presence of inorganic colloids and iron oxides, and ion-exchange characteristics (2). Although mobility through soils to waters, both surface or groundwater, is not a major route of environmental exposure, exposure to lead-bearing soil particles either by ingestion or inhalation can be a route of exposure.

Table J-59
(Continued)

Lead can be incorporated into the body by inhalation, ingestion, dermal absorption, and placental transfer to the fetus. Lead is an accumulative metabolic poison that affects behavior and the hematopoietic, vascular, nervous, renal and reproductive systems. In general, organo-lead compounds are more toxic than inorganic lead compounds, food chain biomagnification is negligible, and younger, immature organisms are most susceptible (3). Although lead does not biomagnify, its concentration in aquatic and terrestrial vertebrates tends to increase with age of the animal. Distribution of lead is localized in hard tissues, such as bones and teeth (6). Ingestion of lead shot from hunter-killed or crippled waterfowl appears to be the major source of lead exposure to bald eagles. Alternatively, ospreys do not ingest those items which contain lead shot or hard tissues that have accumulated lead (7).

The proposed lead criteria for the protection of natural resources and human health recommends for the mouse a daily total intake >0.05 mg/kg and for the mule deer total intake > 3 mg/day (3). Accumulation of lead with age has been reported in pronghorn antelope, but the mule deer did not show accumulation in the same study. Background levels of lead in the livers and kidneys from mule deer and pronghorn antelope range from 0.6 to 0.9 ug/g (freeze dried weight) (8). Lead concentration of > 10 ug/g have been associated with diagnostic lead toxicosis in experimental mammals. However, mammals with behavioral and physiological signs of lead intoxication have died with < 5 ug/g (9). Plants and animals may bioconcentrate lead, but biomagnification has not been detected. Older organisms tend to contain the greatest body burden of lead. In aquatic organisms lead concentrations are usually highest in benthic organisms and algae, and lowest in upper trophic levels predators such as carnivorous fish (2).

Bioacumulation Factor (BAF):
- Earthworm = 0.66 (16)

Bioconcentration Factor (BCF):
- Oyster = 6600 (14)
- Algae = 92,000 (14)
- Rainbow trout = 726 (14)
- Fish = 42 (3)
- Insects = 500 (3)
- Algae = 725 (3)
- Oysters = 536 (3)

References:

1. Health Effects Assessment for Lead USEPA, September 1984.
2. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Lead. 1990.
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Table J-60
Ecological Toxicity Profile for Manganese

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Manganese						
Rat		Gavage-Water	One time as Mn acetate	Death	LD_{50} = 820 mg/kg/day	1
Rat		Gavage-water	One time as $MnCl_2$	Death	8 days LD_{50} = 804 mg/kg/day	1
Mouse		Oral-Food	90 days as Mn_3O_4	Decreased Activity	LOAEL = 140 mg/kg/day	1
Rat		Oral-Food	100-224 days	Reduced testosterone levels	LOAEL = 13 mg/kg/day	1
Rat		Oral-Water	20 days, Gestation days 0-20 as $MnCl_2$	Decreased Litter weight	LOAEL = 1240 mg/kg/day	1
Mouse		Oral-Food	90 days as Mn_3O_4	Delayed growth of testes	LOAEL = 140 mg/kg/day	1
Mouse (male)	1,050 mg/kg	Oral-Food	Chronic	Retarded sexual development		4
Longfin dace (*Agosia chrysogaster*)		Medium	96 hours	Death	LC_{50} = 130 mg/L	5
Meadow vole					NOAEL = 174.45 mg/kg/day	6
Red fox					NOAEL = 37.88 mg/kg/day	6
Terrestrial plant	500 mg/kg in soil			20% reduction in growth		6

Manganese (Mn) is a naturally occurring substance found mainly in many types of rock. It does not occur in the environment as a pure metal, but combined with other chemicals such as oxygen, sulfur and chloride. Some manganese compounds can dissolve in water and low levels of these compounds are normally present in lakes, streams, and the ocean. Manganese can change from one compound to another, but it does not break down or disappear in the environment. The tendency of soluble manganese compounds to adsorb to soils and sediments depends mainly on the cation exchange capacity and the organic composition of the soil (1). Mn occurs in minute concentrations within the cells of all living things and has been established as essential to a wide variety of organisms ranging from bacteria to plants and animals (3).

Table J-60
(Continued)

Mn is a co-factor essential for the activity of many cellular enzymes such as pyruvate, carboxylase, arginase, and phosphatase. Absorption from the gastrointestinal tract is poor under normal conditions because of low solubility of cationic manganese. About 40% of the total body content of Mn is retained in the bone marrow, and the rest is in a freely exchangeable, labile pool. Mn excretion is almost exclusively fecal and involves the liver, pancreas and intestinal wall (4). Intratracheal instillation studies in rabbits indicate that high doses of Mn (160 mg/kg as MnO_2) can cause severe degenerative changes in the seminiferous tubules and lead to sterility. This effect did not occur immediately, but developed slowly over the course of 4-8 months following the exposure. This effect appears to be a concern of high exposure levels (1). Manganese values found in the liver and kidneys of pronghorn antelope and mule deer (6.0-9.4 µg/g freeze dried weight) were similar to concentrations previously reported (2). Average oral LD_{50} in different experimental animals is 400 to 830 mg/kg BW for soluble Mn compounds (4).

Bioconcentration:

Lower organisms (plankton, aquatic plants and some fish) can significantly bioconcentrate Mn. Higher organisms tend to maintain Mn homeostasis. This indicates that the potential for biomagnification from lower trophic levels to higher ones is low. Freshwater fish BCFs of 22.6 for the fathead minnow (5 day exposure) and 12 in the yellow perch (7 day exposure) have been reported (5).

References:

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Table J-61
Ecological Toxicity Profile for Mercury

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Mercury						
Rat		gavage	1 day/1 treatment, inorganic Hg	death	LD_{50} = 29.5 mg/kg/day	1
Rat		oral		reduced fertility	500 µg/kg BW	2
Mouse		gavage	12 days, gestation days 6-17, inorganic Hg	fetal death	LOAEL = 5 mg/kg/day	1
Rainbow trout		medium	96 hours	death	LC_{50} = 155-200 µg/L	2
Treefrogs, *Hyla* spp, 5 spp Embryo-larva		medium	96 hours	death	LC_{50} = 2.4-2.8 µg/L	2
Mallard		trophic	lifetime	reproductive failure	0.91-0.78 µg/g in egg	3
Mallard		oral	14 days, methyl	death	LD_{50} = 2.2-23.5 mg/kg BW	2
Japanese quail		oral	14 days, methyl	death	LD_{50} = 14.4-33.7 mg/kg BW	2
Dog		oral	gestation period	high incidence of stillbirths	0.1 to 0.25 mg/kg BW	2
River otter		oral-diet		fatal	>2.0 mg/kg	2
Mule deer		oral	single dose	death	LD_{50} = 17.88 mg/kg BW	2
Harp seal		oral	26 days	death	25.0 mg/kg BW	2
Guppy/Medaka		medium	3 months as methyl	impaired spermatogenesis	LC50 = 1.8 µg/L	5

Table J-61
(Continued)

The element mercury (Hg) and its compounds have no known normal metabolic function. Presence of mercury in living organisms represents contamination from natural and anthropogenic sources; all such contamination must be regarded as undesirable and potentially hazardous. Forms of mercury with relatively low toxicity can be transformed into forms, mainly methylmercury, with very high toxicity through biological and other processes. Methylmercury can be bioconcentrated in organisms and biomagnified through food chains, returning mercury to upper trophic level consumers in concentrated form. A Bioconcentration Factor (BCF) for mercury ahs been calcualted to be 65 (6). Mercury is a mutagen, teratogen and carcinogen, and causes embryocidal, cytochemical and histopathological effects. High body burdens of mercury normally encountered in some species of fish and wildlife from remote locations emphasize the complexity of natural mercury cycles and human impacts on these cycles. Anthropogenic uses of mercury should be curtailed, because the difference between tolerable natural background levels of mercury and harmful effects in the environment is exceptionally small.

Chemical speciation is probably the most important variable influencing ecotoxicology of Hg. All mercury discharged into rivers, bays or estuaries as elemental mercury, inorganic divalent mercury, phenlymercury or alkoxyalkyl mercury can be converted into methylmercury compounds by natural processes. The mercury methylation in ecosystems depends on mercury loading, microbial activity, nutrient content, pH, and redox conditions, suspended sediment load, sedimentation rates, and other variables. The synthesis of methylmercury by bacteria from inorganic Hg compounds present in the water or in the sediments is the major source of this molecule in aquatic environments. This process can occur under both aerobic and anaerobic conditions, and in both freshwater and saltwater (2). Methylmercury in surface waters is rapidly accumulated by aquatic organisms; concentrations in carnivorous fish at the tops of freshwater and saltwater food chains are biomagnified on the order of 10,000-100,000 times those concentrations found in ambient waters (1).

For all organisms tested, early developmental stages were the most sensitive, and organomercury compounds - especially methylmercury -were more toxic than inorganic forms. Signs of chronic mercury poisoning in fish include emaciation, cataracts, inability to capture food, abnormal motor coordination, and various erratic behaviors (2). Generally, more than 80% of the mercury in fish flesh is in the form of methylmercury (4). Sublethal effects of mercury on birds include adverse effects on growth, development, reproduction, blood and tissue chemistry, metabolism and behavior. Organomercury compounds, especially methylmercury, are the most toxic mercury species to mammals. Larger animals such as mule deer and harp seals appear to be more resistant to Hg than smaller mammals such as mink, cats, dogs, pigs, monkeys, and river otters (2).

References:

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Table J-62
Ecological Toxicity Profile for Methoxychlor

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Methoxychlor						
Rat		Gavage-oil	One time	Death	LD_{50} = 5,000 mg/kg/day	1
Mouse		Gavage	One time	Death	LD_{50} = 2,900 mg/kg/day	1
Rat		Gavage-oil	GD 6-15	Reduced maternal body weight gain	LOAEL = 50 mg/kg/day	1
Rat		Oral-food	16 weeks	Decreased body weight gain	LOAEL = 1,200 mg/kg/day	1
Rat		Oral-food	9 weeks	Reduced fertility in males and female offspring	LOAEL = 60 mg/kg/day	1
Rat		Gavage-oil	56-66 days	Decrease in fertility	LOAEL = 100 mg/kg/day	1
Rat	1,600 mg/kg	Oral-diet	2 years	Reduction in growth		4
Mallard					LD_{50} = >2,000 mg/kg	2
Sharp-tailed grouse					LD_{50} = >2,000 mg/kg	2
Walleye fish			96 hours		LC_{50} = 19.2 µg/L	3
White sucker fish			96 hours		LC_{50} = 260 µg/L	3
Fresh, saltwater aquatic organism			Chronic	Protection of aquatic life	AWQC = 0.3 µg/L	6
Toad (*Bufo americanus*)	0.325 ppm	Oral - food		No adverse effects		7

Table J-62
(Continued)

Methoxychlor was first synthesized in 1893. Commercial production of methoxychlor in the U.S. was first reported in 1946. In 1975, three U.S. companies produced approximately 5.5 million pounds of methoxychlor. U.S. production in 1982 was 3 million pounds. Because of its low toxicity in animals and humans, methoxychlor has been viewed as an attractive replacement for DDT. The EPA has approved the use of methoxychlor as a pesticide and fumigant on more than 85 crops.

Methoxychlor is released to the environment mainly as a result of its application to crops and livestock as a pesticide. Methoxychlor tightly binds to soils, but is not detectable in soil in areas where it has been applied as a pesticide. The degradation of methoxychlor is mediated by microorganisms and is dependent on the aeration of the soil. Half-lives of less than 30 days and greater than 100 days were obtained for methoxychlor in anaerobic and aerobic soils, respectively. Methoxychlor is a relatively hydrophobic compound with a log octanol/water partition coefficient (log K_{ow}) value of 4.68-5.08. Sorption of methoxychlor to bacteria, algae, and fungi has been reported. Methoxychlor has a relatively high K_{oc} value (K_{oc} = 4.9) and has the potential to undergo significant adsorption to soils, especially those with high organic carbon content. The mobility of methoxychlor may be higher in sandy soils, since adsorption is significantly less in soil with lower organic carbon content and larger particle size.

The bioconcentration of methoxychlor has been investigated in microorganisms, lower invertebrates and in fish. Reported bioconcentration factors (BCFs) for methoxychlor range from 348-1,130 in stoneflies, 5,000-8,570 in snails, and 1,500 in clams. In sheepshead minnows, BCFs were found to be concentration dependent, ranging from 113 at 3 µg/L to 264 at 23 µg/L. Since methoxychlor is rapidly metabolized and eliminated, biomagnification up the food chain does not appear to be of concern (1).Methoxychlor is environmentally degradable and will not be stored in high concentrations in most organisms (5).

References:

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Table J-63
Ecological Toxicity Profile for Methyl Isobutyl Ketone

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Methyl Isobutyl Ketone						

Environmental Fate:
- Log K_{ow} = 0.72 (1)

Bioconcentration Factor (BCF):
- BCF = 2.1 (1)

References:

1. Sims and Hansen, Soil, Transport, and Fate Database, Version 2.0, Utah State University, April 1991.

Table J-64
Ecological Toxicity Profile for Methylene Chloride

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Methylene Chloride						
Chicken embryo		Injection into egg airspace	Single dose	Death, developmental abnormalities	LD_{50} = 8.49 mg/L	1
Rat	500 - 3,500 ppm	Inhalation	6 hr/day 5 days/wk, for 1 yr	Increased mortality at 3500 ppm		2
Dog	1,000 ppm		5 -7 wk, continuous	Liver, splenic and respiratory effects		3
Rat		Oral	Single dose	Death	LD_{50} = 1,600 mg/kg	4
Fish		Oral	96 hr	Death	LC_{50} = 193 mg/L	4
Fish		Oral	48 hr	Death	EC_{10} = 66.3 mg/L	4
Fish		Oral	48 hr	Deach	LC_{10} = 51.2 mg/L	4
Rat		Inhalation	6 hr/day/2 yrs	Endocrine tumors	TCLo = 3,500 ppm	5
Mouse		Inhalation	5 hr/day/2 yrs	Respiratory system tumors	TCLo = 2,000 ppm	6
Rat		Oral	Single dose	Neurological effects	LD_{50} = 1,600 mg/kg	7
Meadow vole					NOAEL = 11.59 mg/kg/day	9
Red fox					NOAEL = 2.51 mg/kg/day	9
Fathead minnow (*Pimephales promelas*)		Medium	96 hours; flow-through	Death	LC_{50} = 193 mg/L	10
Water flea (*Daphnia magna*)				Death	LC_{50} =224 mg/L	10

Table J-64
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Methylene Chloride						
Water flea (*Daphnia magna*)				Death	LC_{50} =224 mg/L	10
Alfalfa seedling	21%	Vapors		Photosynthesis reduced 82%		11
Freshwater algae			96 hours		EC_{50} > 662 mg/L	11

Methylene chloride is a widely used industrial chemical with reported emissions to air of more than 126 million pounds annually in the U.S. Because methylene chloride is a highly volatile substance (Henry's Law constant of 0.002 atm-m^3/mol), most environmental releases are to the atmosphere. Methylene chloride is degraded in the atmosphere by reaction with hydroxyl radicals, with an atmospheric lifetime of less than one year. The compound is expected to by highly mobile in soil and to volatilize rapidly from surface water. Bioconcentration does not appear to be significant (8).

Bioconcentration:
- Estimated at 5 from Kow using linear regression
- BCF (derived) = 2.3

Environmental Fate:
- Log K_{ow} = 0.95
- Log K_{oc} = 1.68

References:

1. IARC. Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man. Geneva: World Health Organization, International Agency for Research on Cancer, 1972-present. V41 60 (1986)
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3. NIOSH/OSHA - Occupation Health Guidelines for Chemical Hazards.
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5. Fundam Appl Toxicol, vol4, pg 30, 1984.
6. NTIS, vol NTP-TR-306, 1086.
7. Food Arg Organ UN Rep Ser, vol 48A, pg 94.
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Table J-65
Ecological Toxicity Profile for Molybdenum

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Molybdenum						
Rat	10 mg/kg	Oral-food		Impaired reproductive performance		1
Cattle	2-100 mg/kg	Oral-food		Diarrhea, weight loss, infertility		1
Rabbit	70-80 mg/kg	Intratracheal	9 months	Pneumoconiosis		2
Cattle	20-100 mg/kg	Oral-food		Sterility in bulls		3
Mouse					LD_{LO} = 448 mg/kg	4
Rat					LD_{LO} = 6.05 mg/kg	4
Bleugill			96 Hours		LC50 = 1320 mg/L	6
White Rabbit	100 mg Mo/Kg ration	Diet	Lifetime	Reduced growth; skeletal and joint defoemities		6
Mussel (larvae)	147 mg/L		48 Hours	Development reduced by 50%		6

The industrial uses of molybdeum include the manufacture of high temperature resistant steel alloys for use in gas turbines and jet aircraft engines, production of catalysts, and lubricants and dyes.

Molybdenum is an essential metal as a cofactor for the enzymes xanthine oxidase and aldehyde oxidase. In plants it is necessary for fixing of atmospheric nitrogen by bacteria at the start of protein synthesis. Because of these functions it is ubiquitous in food. Plankton tend to concentrate molybdenum, so shellfish tend to have high concentrations of molybdenum.

While molybdenum exists in various valence forms, biologic differences with respect to valence are not clear. The soluble hexavalent compounds are well absorbed from the gastrointestinal tract into the liver. Pastures containing 20 to 100 ppm molybdenum may produce a disease referred to as "teart" in cattle and sheep. It is characterized by anemia, poor growth rate, and diarrhea. Copper or sulfate in the diet prevent the disease. Prolonged exposure to molybdeum has led to deformities in the joints (5).

Bioconcetration:
- Blue green alga BCF = 3300 (60 minutes)
- Clam BCF = 1.8
- Amohipod BCF = 4.8
- Freshwater alga BCF = 628 (25 days)
- Steelhead trout Max BCF = 1143

References:

1. National Research Council, Canada, Data Sheet on Selected Toxic Elements, NRCC. No 19252, 1982.
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Table J-66
Ecological Toxicity Profile for Naphthalene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Naphthalene						
Mice		Gavage	1/day for 8 days	Death	LD_{50} = 354 mg/kg	1
Rat		Oral	Not specified	Death	LD_{50} = 2,200 mg/kg	1
Mouse		Gavage	1/day for 14 days	Reduced litter size	LOAEL = 300 mg/kg/day	1
Mouse		Gavage	1/day for 14 days	Decrease in body, spleen and thymus weight	LOAEL = 267 mg/kg/day	1
Mice	200 mg/kg	Interperitoneal injection	Single	Pulmonary damage after 24 hrs		2
Rodent		Oral	Acute	Death	LD_{50} = 1,780 mg/kg-BW	3
Pink salmon, fry (*Oncorhyrchus gorbuscha*)			24 hour	Death	LC_{50} = 920 ug/L	3
Grass shrimp			96 hour	Death	LC_{50} = 2400 ug/L	3
Sandworm			96 hour	Death	LC_{50} = 3800 ug/L	3
Mosquito fish			96 hour	Death	LC_{50} = 150,000 ug/L	3
Sheepshead minnow		Habitat concentration	24 hour	Death	LC_{50} = 2,400 ug/L	3
Mallards	4,000 mg/kg	Oral	7 Months	Increased liver weight and hepatic blood		3
Rabbit	1 gm/kg/day	Oral	2 Weeks	Cataract formation		4
Freshwater aquatic organisms			Chronic	Proposed AWQC - protection of aquatic life	LOEL = 620 ug/L	5

Table J-66
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Naphthalene						
Fathead Minnow (*Pimephales promelas*)		Medium	72 hour	Death	LC_{50} = 1700 ug/L	6
Channel catfish (*Ictalurus punctatus*)		Medium	96 hour	Death	LC_{50} = 1720 ug/L	6
Snail (*Aplexa hynorum*)		Medium	96 hour	Death	LC_{50}> 2040 ug/L	6

Naphthalene is a polycyclic aromatic hydrocarbon (PAH) produced during petroleum refining, coal tar production, resin and dye production and mothball manufacture and use. In the environment, naphthalene is adsorbed moderately by soils and sediment (Log K_{ow} = 3.29, Log K_{oc} = 2.97). Surface evaporation and biodegradation are important removal processes. Naphthalene is expected to bioconcentrate to a moderate degree in fish and aquatic invertebrates (Log BCF = 1.6 - 3.0). Naphthalene is considered moderately toxic affecting the liver, spleen, lungs and CNS. Cataract formation has also been observed in test animals. Evidence suggest that naphthalene is noncarcinogenic.

Bioconcentration Factor (BCF):
- Clam (24 hrs.) = 6
- Sandworm (3-24 hrs.) = 40
- Atlantic salmon, egg (168 hrs.) = 44-83
- *Daphnia pulex* (24 hrs.) = 131
- Bluegill (24 hrs.) = 310

References:

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Table J-67
Ecological Toxicity Profile for Nichol

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Nickel						
Rat		Gavage	one time as $NiSO_4$	Death	LD_{50} = 66 mg/kg/day	1
Rat		Gavage	one time as Ni acetate	Death	LD_{50} = 116 mg/kg/day	1
Mouse		Gavage	one time as Ni acetate	Death	LD_{50} = 136 mg/kg day	1
Mouse		Oral-water	6 or 30 hours as Ni nitrate	Abnormal sperm	LOAEL = 23 mg/kg/day	1
Mouse		Oral-water	6 or 30 hours as Ni chloride	Abnormal sperm	LOAEL = 43 mg/kg/day	1
Mouse		Oral-water	6 or 30 hours as Ni sulfate	Abnormal sperm	LOAEL = 28 mg/kg/day	1
Rat		Oral-food	3 generations	Decreased number of offspring per litter	LOAEL = 50 mg/kg/day	1
Rat weanling	500 and 1,000 mg/kg	Oral-food	6 weeks as Ni acetate	Decreased body weight gain		3
Rat	225 mg/L	Oral-water	4 months as Ni chloride	Reduced body weight		3
Rat	25 mg/kg BW/day	Gavage	120 days as Ni sulfate	Testicular changes		3
Cattle	1,000 ppm	Oral-food as Ni carbonate	8 weeks	Decreased food intake, growth rate, organ size and nitrogen retention		2
Freshwater Aquatic Organisms		Medium	Chronic		LEOC = 0.0083 mg/L	5

Table J-67
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Nickel						
Mallard	700 mg/kg	Applied to shell surface	18 days	Embryonic mortality		4
Terrestrial plants	30 mg/kg in soil			20% Decrease in plant growth		6

Nickel is used in combination with other metals to make alloys, which are used in making coins and jewelry and in industry for making items such as valves and heat exchangers. Most nickel is used to make stainless steel. Nickel compounds are also used for nickel plating, to color ceramics, to make batteries, and as catalysts (1).

The aquatic fate of nickel has been studied extensively. In most aerobic environments, nickel may exist in solution as hydroxide, carbonate, sulfate and organic complexes. Soils containing iron and manganese oxides may sorb nickel significantly. Under acidic conditions, nickel is more mobile in soil and may seep into groundwater. Soils rich in organic matter may enhance the mobility of nickel through complexation. Nickel occurs in the 0 and +2 valence states (3). Nickel does not appear to concentrate in fish nor accumulate in plants or small animals (1).

Nickel is an essential element required for growth and iron absorption. Data on the toxicity of nickel have shown wide variations in the amounts of nickel to produce harmful effects (2). In one study 5 ppm of nickel in drinking water of rats from weaning caused death of young in 3 generations and runting in the first and third generations. 500 ppm nickel reduced growth in chicks. For cattle, the maximum tolerable level was set at 50 ppm (2).

Bioconcentration:
BAFs (aquatic organisms) range from <220 for marine plankton to 40,000 in an algae. The bioaccumulation factor in edible fish, may not exceed 100 (3).

References:

1. Agency for Toxic Substance and Disease Registry (ATSDR). Toxicity Profile for Nickel 1991.
2. Mineral Tolerance of Domestic Animals, National Academy of Sciences, Washington D.C., 1980.
3. Health Effects Assessment for Nickel. U.S. EPA, EPA/540/1-86/018, September 1984.
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6. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge, TN, 1994.

Table J-68
Ecological Toxicity Profile for Phenanthrene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
			Phenanthrene			
Mouse		Oral	Not specified	Death	LD_{50} =700 mg/kg	1
Mouse	71 mg/kg	Applied to skin	Not specified	Tumor formation at site of application	Not specified	2
Mallard	4,000 mg/kg in diet (PAH mixture)	Oral	7 months	Increased liver weight and hepatic blood flow	Not specified	3
Grass shrimp		Medium	24 hour	Death	LC_{50} = 370 ug/L	3
Sandworm		Medium	96 hour	Death	LC_{50} = 600 ug/L	3
Freshwater aquatic organism			Chronic	Proposed AWQC - protection of aquatic life	LOEL = 6.3 ug/L	5
Saltwater aquatic organism			Chronic	Proposed AWQC - protection of aquatic life	LOEL = 4.6 ug/L	5
Mouse		Intravenous injection	Not specified	Death	LD_{50} = mg/Kg	4
Rat	150 mg/kg-BW	Intraperitoneal injection	Not specified	Changes in blood chemistry and nephrotoxicity	Not Specified	3

Phenanthrene is a polycyclic aromatic hydrocarbon (PAH) that is a byproduct of incomplete combustion. In the environment, phenanthrene adsorbs strongly to soil and sediment (K_{ow}=2.4 × 10^4, K_{oc}=1.4x10^4) and is considered to be relatively immobile. It is not expected to leach to groundwater. Subject to bioconcentration if organism does not posses microsomal oxidase. Phenanthrene has tested negative as a complete carcinogen.

Bioaccumualtion Factor (BAF):
- Earthworm = 0.12 (6)

Bioconcentration Factor (BCF):
- Clam (24 hrs.) = 32 (3)
- *Daphnia pulex* (24 hrs.) = 325 (3)

References:
1. Lewis R.J., Sax's Dangerous Properties of Industrial Materials. Van Nostrand Reinhold, NY. 1987.
2. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Polycyclic Aromatic Hydrocarbons 1989.
3. Eisler, R. Polycyclic Aromatic Hydrocarbons Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review. 1987.
4. US Army Data NIOSH Exch Chem.
5. Federal Ambient Water Quality Criteria. Federal Register Notice 57FR60848.
6. Beyer, W.N. Evaluating Soil Contamination. U.S. Fish and Wildl. Serv., Biol. Rep. 90(2). 25 pp., 1990.

Table J-69
Ecological Toxicity Profile for Phenol

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Phenol						
Rat	980 mg/kg/day	Oral-water	2 generations	Below normal growth in young		1
Freshwater aquatic organism			Chronic		LOEL = 2560 ug/L	3
Rat	1,120 mg/kg/day	Oral-water	2 generations	Impaired mothering behavior, increased mortality rate among young, decreased growth rate		1
Guinea pig	26-32 ppm	Inhalation	7 hours/day 5 days/week 29 exposures	Weight loss, respiratory distress, paralysis, death		2
Freshwater aquatic organisms			Chronic	Proposed AWQC - protective of aquatic life	LOEL = 2560 μg/L	3
Water flea (*Daphnia magna*)				Death	LD_{50}= 16 mg/L	5
Rainbow trout			24 hours -static	Death	LC_{50} = 5.6-11.3 mg/L	5

Phenol is mainly a man-made chemical, although it is found in nature in animal wastes and organic material. The largest single use of phenol is to make plastics, but it is also used in the production of nylon and epoxy. Other uses include slimicides and disinfectants. Phenol is released primarily to the air and water as a result of its manufacture and use, and as a result of woodburning and auto exhaust. Phenol disappears rapidly in the air by gas-phase hydroxyl radical reaction. In soil, phenol will generally biodegrade rapidly, although if present in sufficient concentration, biodegradation will be hindered. Since plants can metabolize phenol readily, exposure through eating food derived from plants grown in phenol-containing soils is probably minimal. Phenol is not expected to bioconcentrate significantly in aquatic organisms (4).

Bioconcentration:
- BCF = 20

Environmental Fate:
- Log K_{ox} = 16.2-91
- Log K_{ow} = 1.46

References:

1. Environmental Protection Agency (USEPA). Health Effects Assessment for Phenol. July 1989.
2. Environmental Protection Agency (USEPA). Summary Review of the Health Effects Associated with Phenol: Health Issue Assessment. May 1986.
3. U.S. Environmental Protection Agency (EPA), 1991, **Water Quality Criteria Summary**: Office of Science and Technology, Health, and Ecological Criteria Division, Washington, D.C. May.
4. Agency for Toxic Substance and Disease Registry (ATSDR). Toxicological Profile for Phenol. 1989.
5. Hazardous Substances Data Base (HSDB), 1994, On-Line Computer Database: U.S. Department o Health and Human Services., Bethesda, MD.

Table J-70
Ecological Toxicity Profile for Pyrene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Pyrene						
Guinea pig	5 mmol	Dermal	Single dose	Phototoxic when subsequently exposed to UV light.		1
Rat, Mice	50-90 ug/m3	Inhalation	22 months	Lung neoplasia 10x above controls.		2
Mosquito fish		Medium	96 hr	Death	TLm = 0.0026 mg/L	3
Rat		Oral	Acute	Death	LD_{50} = 2,700 mg/Kg	4
Mouse		Oral	Acute	Death	LD_{50} = 800 mg/Kg	4
Mice	10 % pyrene solution	Applied to skin	Lifetime	No skin tumors		6
Mice		IP injection	Single	Death	LD_{50} = 680 Kg-BW	6
Rat	150 mg/kg	IP injection	Single	Altered blood chemistry and nephrotoxicity		5
Mice	127 mg/kg	Oral-Food	25 Days	Dialation of renal tubules		6

Pyrene is a polycyclic aromatic hydrocarbon (PAH) that is a byproduct of incomplete combustion. In the environment, pyrene adsorbs strongly to soil and sediment (K_{ow}=8.0x10^4, K_{oc}=3.8x10^4). It is not expected to leach to groundwater and will not hydrolyze or evaporate significantly. Laboratory tests with soil microbes indicate probable biodegradation. Bioaccumulation, especially in vertebrate organisms, is not considered an important fate process. Pyrene has been shown to be acutely toxic at high doses. Evidence suggests that pyrene may be slightly genotoxic. Pyrene is a questionable carcinogen.

Bioaccumulation Factor (BAF):
- Earthworm = 0.09 (7)

Bioconcentration Factor (BCF):
- *Daphnia pulex* (24 hrs.) = 2702 (6)
- Rainbow trout, liver (21 days) = 69 (6)

Environmental Fate:
- Log K_{ow} = 4.9
- Log K_{oc} = 4.58

References:

1. Kochevar IE et al; Photochem Photobiol 36(1):6509(1982).
2. Heinrich U et al; Exp Pathol 29 (1):29-34(1986).
3. Verschueren, K. Handbook of Environmental Data of Organic Chemicals. 2nd ed. New York, NY: Van Nostrand Reinhold Co., 1983., p.1034.
4. Sax's Dangerous Properties of Industrial Materials, Richard J. Lewis 8th ed.
5. Eisler, R. 1987. Polycyclic aromatic hydrocarbon hazards to fish, wildlife, invertebrates: a synoptic review. U.S. Fish Wildl. Serv. Biol. Rep. 85(1.11). 81 pp.
6. Agency for Toxic Substances and Disease Registry. (ATSDR). Toxicological Profile for Polycyclic Aromatic Hydrocarbons. 1989.
7. Beyer, W.N. Evaluating Soil Contamination. U.S. Fish and Wildl. Serv., Biol. Rep. 90(2). 25 pp., 1990.

Table J-71
Ecological Toxicity Profile for Selenium

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Selenium						
Rat		Gavage	one time as elemental Se	Death	LD_{50} = 6,700 mg/kg/day	1
Rat		Gavage	one time as selenite	Death	LD_{50} = 7 mg/kg/day	1
Rat		Oral-Water	1 year as selenate	Reduced Survival	LOAEL = 1.05 mg/kg/day	1
Rat		Oral-Water	4-6 weeks as selenite	4/6 died - males	LOAEL = 0.69 mg/kg/day	1
Mouse		Oral-Water	48 days as selenite	Reduced fetal growth	LOAEL = 0.34 mg/kg/day	1
Rat		Oral-Water	1 year as Potassium selenate	50% reduction in reproduction	LOAEL = 0.35 mg/kg/day	1
Pig		Oral-Food	6 weeks as selenite	fetal/maternal toxicity	LOAEL = 0.41 mg/kg/day	1
Mouse		Oral-Water	3 generations as selenate	50% reduction in offspring number	LOAEL = 0.42 mg/kg/day	1
Mouse		Oral-Water	3 generations as selenate	fetal lethality	LOAEL = 0.42 mg/kg/day	1
Rainbow trout	13 µg/g	Oral-Food	20 weeks	reduced growth, poor feed conversion efficiency, reduced survival		3
Black-necked stilt		Trophic	lifetime	low hatchability	> 8 mg/kg in egg	4
American coot		Trophic	lifetime	20% probability of embryo death or deformity	3.2 µg/g in egg	5

Table J-71
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Selenium						
Mallard	60 mg/kg	Oral-Diet	4 weeks	reduced growth		6
Mallard	15 ppm	Oral-Diet	20 days as selenomethionine	embryo mortality	5 ppm in egg	9
Fathead minnow	20 ppm	Diet	98 days	growth inhibition		8
Fathead minnow		Medium	24 hours as selenate	death	LC_{50} = 82 mg/L	10
Mallard	10 ppm	Oral-Food	as selenomethionine	80% reduction in reproductive success		11
Meadow vole					LOAEL = 1.23 mg/kg/day	12
Red fox					LOAEL = 0.268	12
Terrestrial plants	1 mg/kg	Soil		20% reduction of growth		12

Selenium is nutritionally important as an essential trace element in terrestrial and aquatic systems, but is harmful at slightly higher concentrations. Selenium deficiency is not as well documented as selenium poisoning, but may be equally significant. Selenium released as a result of anthropogenic activities, as well as that in naturally seleniferous areas pose the greatest threat of poisoning fish and wildlife. Metabolism and degradation are significantly modified by interactions with various heavy metals, agricultural chemicals, microorganisms, and numerous physicochemical factors (2). In environments favoring the soluble forms of selenium (alkaline and oxidizing conditions) the soluble forms of selenium (principally sodium selenate) can be accumulated by plants. Bioaccumulation has been documented in aquatic environments and some evidence indicates that under natural condition selenium might biomagnify in aquatic organisms. A Bioconcentration Factor (BCF) for trout has been determined to be 10.5 (1).

Biological responses to selenium deficiency or to selenosis vary widely, even among closely related taxonomic groups. Selenium deficiency may be prevented in fish, small laboratory mammals and livestock by feeding diets containing 50 to 100 ppb of selenium. Dietary selenium is toxic to fish in the range of 3-5 µg/g (3). Growth inhibition in fish is a commonly reported response to elevated selenium in the diet (8). Proposed Se criteria for prevention of Se deficiency and for protection against selenosis include:

Rats - 54-84 ppb in diet; Cattle - 20 ppb in diet; Sheep and Cattle - 100 ppb in diet; and
Drinking water for livestock - < 50 ppb (2).

Selenium in natural foods is less toxic (approximately 1/4 as toxic) than purified forms of selenium. Toxicity is prevented in livestock if dietary Se concentrations do not exceed 5,000 ppb in natural forage or 2,000 ppb in feeds supplemented with purified Se. Ingestion of minerals and rough or high protein feeds reduces Se toxicity, and exposure by diet is less toxic than exposure parenterally or by inhalation (1). Acute Se poisoning is seen in sheep at concentrations of 3.2-12.8 mg/kg BW. The minimum lethal dose of Se as selenite for horses and mules = 3.3 mg/kg BW, cattle = 11 mg/kg BW, and 15 mg/kg BW for swine. Acute poisoning is associated with plant materials containing 400 to 800 ppm selenium. Exposure to natural selenite, selenate or seleniferous feed resulted in chronic selenosis in rats at 1 ppm, and horses at 44 ppm. The LOEL for rats (a sensitive species) based on longevity was 0.75 mg/kg (2). Sodium selenite in the diet of mallards was not particularly teratogenic compared to selenomethionine. This is in contrast to findings with mice (7). In nature, a female mallard would have to feed in a selenium-contaminated area for a short time before her eggs contained harmful concentrations of selenium (9).

Table J-71
(Continued)

Non-lethal effects of selenium include reproductive anomalies. Selenosis caused congenital malformations in rats, mice, swine and cattle. Young born to females with selenosis were emaciated and unable to nurse. Mice given Se in drinking water reproduced normally for three generations, but litters were fewer and smaller when compared to controls, pups were runts with high mortality before weaning, and most survivors were infertile (2). Teratogenicity caused by selenium has yet to be adequately established in mammals. Selenium exposure has been shown to induce cataracts in neonatal rats, guinea pigs, and rabbits. Controlled experiments feeding selenium as selenomethionine to pregnant rhesus monkeys failed to produce significant birth defects even though maternal and fetal toxicity occurred (7).

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Selenium. 1989.
2. Eisler, Ronald. Selenium Hazards to Fish, Wildlife, and Invertebrates: A synoptic review, Fish and Wildlife Service, October 1985.
3. Hamilton, S.J., Buhl, K.J., Faerber, N.L., Wiedmeyer, R.H., and F.A. Bullard. "Toxicity of Organic Selenium in the Diet of Chinook Salmon" Env. Tox. Chem. Vol 9. pp 347-358. 1990.
4. Skorupa, J.P., and H.M. Ohlendorf "Contaminants in Drainage Water and Avian Risk Thresholds" In: The Economics and Management of Water and Drainage in Agriculture. A. Dinar, D. Zilberman (eds.) Kluwer Academic Publishers, 1991.
5. King, K.A., Custer, T.W., and J.S. Quinn "Effects of Mercury, Selenium and Organochlorine Contaminants on Reproduction of Forster's Terns and Black Skimmers Nesting in a Contaminated Texas Bay" Arch. Environ. Contam. Toxicol. Vol 20, pp. 32-40, 1991.
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9. Heinz, G.H. "Selenium Accumulation and Loss in Mallard Eggs." Env. Tox. and Chem. 12:775-778, 1993.
10. Pyron, M. and T.L. Beitinger "Effect of Selenium on Reproduction Behavior and Fry of Fathead Minnows" Bull. Environ. Contam. Toxicol. 42:609-613 1989.
11. Heinz G.H., Hoffman, D.J., and L.G. Gold "Toxicity of Organic and Inorganic Selenium to Mallard Ducklings" Arch Envir Contam. Toxicol. 17:561-568. 1988.
12. Screening Benchmarks for Ecological Risk Assessment, Environmental Sciences and Health Sciences, Research Division, Oak Ridge National Labs, Oak Ridge, TN, 1994

Table J-72
Ecological Toxicity Profile for Tetrachloroethene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Tetrachloroethene						
Rat (female)		Gavage (Oral)	1 day 1 time	Death	LD_{50} = 3,005 mg/kg/day	1
Mouse (female)		Oral	78 weeks 5 days/wk	Cancer effect level	LOAEL = 386 mg/kg/day	1
Mouse	100-1600 ppm	Inhalation	6 hours/day 5 days/week 13 weeks	Death	Mortality at 1600 ppm	2
Water Flea (*Daphnia magna*)			48 Hours - static test	Death	LC_{50} = 18 mg/L	3
Meadow vole					NOAEL = 1.23 mg/kd/day	4
Red fox					NOAEL = 0.268 mg/kg/day	4

Environmental Fate:
- Log K_{ow} = 3.40
- Log K_{oc} = 2.2-2.7
- Vapor Pressure at 25°C = 18.47 mmHg
- Henry's Law Constant = 1.8×10^{-2} atm-m^3/moL at 25°C

Bioconcentration:
- Bluegill BCF = 49 (2)
- Rainbow trout BCF = 39 (2)

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Tetrachloroethene, 1993.
2. U.S. EPA Updated Health Effects Assessment for Tetrachloroethylene, EPA/600/8-89/096, Feb 1988.
3. Hazardous Substances Data Base (HSDB), 1994, On-Line Computer Database. U.S. Department o Health and Humans Services, Bethesda, MD.
4. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge, TN, 1994.

Table J-73
Ecological Toxicity Profile for Thallium

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Thallium						
Fathead minnow		Medium	96 hours	Death	$LC_{50} = 860\ \mu g/L$	1
Fresh water organisms		Medium	Chronic		LOEL = 40 µg/L	3
Rat		Oral - water	30 - 60 days	Histological alteration of testes	LOAEL = 0.7 mg/kg/day	2

Pure thallium is a soft, bluish-white metal that is widely distributed in trace amounts in the earth's crust. In its pure form, it is odorless and tasteless. Thallium remains in the environment since it is a metal and cannot be broken down to simpler substances. Thallium is used in the manufacture of electronic devices, switches and closures. Major releases to the environment are from processes such as coal-burning and smelting (2).

Bioconcentration Factor (BCF):
- Clams = 18.2
- Mussels = 11.2
- Sunfish = 34
- Atlantic salmon = 27-1430
- Thallium is absorbed by plants from soil and thereby enters the terrestrial food chain (2).

References:
1. LeBlanc,G.A., and J.W. Dean "Antimony and Thallium Toxicity to Embryos and Larvae of Fathead Minnows (Pimephales promelas). Bull. Environ. Contam. Toxicol. 32:565-569. 1984
2. Agency for Toxic Substance and Disease Registry (ATSDR) Toxicological Profile for Thallium. 1992.
3. U.S. Environmental Protection Agency (EPA), 1991, Water Quality Criteria Summary: Office of Science and Technology, Health and Ecological Criteria Division, Washington, D.C.

Table J-74
Ecological Toxicity Profile for Toluene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Toluene						
Rat		Oral	Single dose	Death	LD_{50} = 2.6 - 7.5 g/kg	1
Catfish		Oral	96 hr	Death	LC_{50} = 240 mg/L	2
Striped bass		Oral	96 hr	Death	LC_{50} = 7.3 mg/L	3
Rat		Oral	Single dose	Death	LD_{50} = 636 mg/Kg	4
Mouse		Oral	Single dose	Fetal death	TD_{Lo} = 9 g/kg	5
Mouse		Oral	Single dose	Fetotoxicity	TD_{Lo} = 15 g/kg	5
Mouse		Oral	Single dose	Fetal abnormalities	TD_{Lo} = 30 g/kg/L	5
Mouse		Oral	13 weeks	Neural, liver, renal changes	TD_{Lo} = 227 g/kg	6
Rabbit		Inhalation	14 days, 24 hr/day	Abortion	LOAEL = 267 ppm	7
Fresh water aquatic organisms			Acute	Proposed AWQC - Protection of aquatic life	LOEL = 17,500 mg/L	8
Saltwater aquatic organisms			Chronic	Proposed AWQC - Protection of aquatic life	LOEL = 5 µg/L	8
Meadow vole					NOAEL = 22.9 mg/kg/day	10
Red fox					NOAEL = 4.9 mg/kg/day	10
Terrestrial Plant				20% reduction in plant growth	LOEC = 200 mg/kg soil	10
Grass shrimp (*Palaemonetes pugio*)			96 hour	Death	LC_{50} = 9.5 ppm	11

Table J-74
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Fathead minnow (*Pimephales promelas*)			96 hour	Death	LC_{50} =34.27 mg/L	11
Water flea (*Daphnia magna*)			48 hour	Death	LC_{50} =313 mg/L	11
Mosquito larvae				Death	LC_{50}=22 mg/L	11
Grain weevil (*Calandra granaria*)		Inhalation		Death	LC_{50}=55-72 mg/L	11
Fathead minnow			96 hour - flow through	Death	LC_{50}=36.2 mg/L	11
Copepod (*Nitocra spinipes*)			24 hour	Death	LC_{50}=24.2-74.2 mg/L	11
Goldfish (*Carassius auratus*)			96 hour	Death	LC_{50}=57.68 mg/L	11

Gasoline contains approximately 5-7% toluene by weight. Toluene in the atmosphere is degraded by reaction with hydroxyl radicals, with a typical half-life of about 13 hours. Toluene in soil or water tends to volatilize to air and that which remains is subject to microbial action. Depsite its lipid solubility, the BCF for toluene is expected to be relatively low because of its rapid metabolism to more polar molecules with a lower affinity for lipids. It has little tendency to bind to biomolecules. Available data suggest that toluene does not biomagnify in the environment. On the basis of its lipophilic properties, toluene is expected to have a moderate tendency to bioconcentrate in the fatty tissues of aquatic organisms. BCFs were estimated to be about 10.7 in fish and about 4.2 in mussels (7).

Bioconcentration:
- Golden ide fish BCF = 90
- Eel (*Anguilla japonica*) BCF = 13.2
- Bluegill BCF = 20
- Crayfish (*Orconectes resticus*) BCF = 24.5 (9)

Environmental fate:
- Log Kow = 2.69, high to moderate mobility in soil. May leach into groundwater.
- Will evaporate rapidly from water.

References:

1. DHHS/NTP; Toxicology and Carcinogenesis Studies of Chlorobenzene in F344/N Rats and B6C3F1 Mice (Gavage Studies) p. 16(1990) Technical Rpt Series No. 371 NIH Pub No. 90-2826.
2. Johnson WW, Finley MT; Handbook of Acute Toxicity of Chemicals to Fish and Aquatic Invertebrates p.85 (1980) as cited in Environment Canada; Tech Into for Problem Spills: Toluene p. 71-75 (1981).
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8. EPA. Water Quality Criteria Summary. Office of Science and Technology, Health and Ecological Criteria Division, Washington. D.C. 1991.
9. EPA Health Assessment for Toluene. EPA/540/1-86/003. 1984.
10. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences & Health Sciences Research Division. Oak Ridge National Labs. Oak Ridge, TN. 1994.
11. Hazardous Substance Data Base (HSDB). On-line Computer Database. U.S. Department of Health and Human Services, Bethesda, MD. 1995.

Table J-75
Ecological Toxicity Profile for Trichloroethene

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Trichloroethene						
Rats		Inhalation	4 hours	Death 50%	LC_{50} = 12.500 ppm	1
Mice		Inhalation	4 hours	Death 50%	LC_{50} = 8,450 ppm	1
Rats		Inhalation	4 hours/day 13 days	Complete litter resorption	LOAEL = 100 ppm	1
Dog		Oral	1 time	Death	LD_{50} = 5,680 mg/kg	1
Mice		Oral	5 days/wk 103 weeks	Death Liver tumors	LOAEL = 1,000 mg/kg	1
Rabbits		Dermal	1 time	Death	LD_{50} = 29 g/kg	1
Rat				death	LOAEL = 6,000 - 7,000 mg/kg	1
Cat				death	LOAEL = 6,000 - 7,000 mg/kg	1
Rabbit				death	LOAEL = 6,000 - 7,000 mg/kg	1
Rat		Inhalation	7 hours/day 5 day/week 6 months	significant reductions in body weight gain	400 ppm	1

No embryo toxicity or teratogenicity in rats or mice (2).

Environmental Fate:
- Log K_{ow} = 2.42
- Vapor Pressure at 25°C = 74 mmHg
- Henry's Law Constant at 25°C = 1.1×10^{-2} atm-m^3/moL
- Insoluble in water, highly soluble in lipids (2).

References:
1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Trichloroethene, 1990.
2. American Conference of Governmental Industrial Hygienists (ACGIH) Documentation of TLVs and BEIs, 6th Edition. Cincinnati, Ohio, 1991.

Table J-76
Ecological Toxicity Profile for Trichlorofluoromethane

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Trichlorofluoromethane						
Guinea Pig		Inhalation	30 min	Death	LD_{50} = 250,000 ppm	1
Rat		Inhalation	30 min	Death	LD_{50} = 100,000 ppm	1
Rabbit		Inhalation	30 min	Death	LD_{50} = 250,000 ppm	1
Hamster		Inhalation	4 hours	Death	LC_{50}571 g/m^3	1

References:
1. Hazardous Substance Data Bank (HSDB). Bethesda, MD, U.S. Department of Health and Human Services, National Library of Medicine, TOXNET files, December 1994.

Table J-77
Ecological Toxicity Profile for Vanadium

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Vanadium						
Mouse		Gavage-water	One time	Death	LD_{50} = 31 mg V/kg/day	1
Rat		Gavage	60 days	Reduced pup length and weight	LOAEL = 2.1 mg V/kg/day	1
Rat		Gavage-water	60 days	None	NOAEL = 8.4 mg V/kg/day	1
White Leg-horn hens	300 ppm	Oral-food		Severe depression in egg production		3
Sheep	9.7-12 mg/kg-BW	Oral-capsule		Decline in feed intake		4
Sheep	40 mg/kg-BW	Oral-capsule		Death		4
Mallard	700 ppm	In oil applied to egg	One time	Reduced embryonic growth; birth defects		2

The transport and partitioning of vanadium in water and soil is influenced by pH, redox potential and the presence of particulate. The partitioning of vanadium between water and sediment is strongly influenced by the presence of particulate in the water. In general, marine plants and invertebrates contain higher levels of vanadium than terrestrial plants and animals. Uptake of vanadium into the above-ground parts of many plants is low. Vanadium appears to be present in all terrestrial animals, but, in vertebrates, tissue concentrations are often so low that detection is difficult. No data are available regarding biomagnification of vanadium within the food chain (1). Egg production has been suppressed in laying hens fed vanadium and lipid metabolism altered in laying mallard hens (2).

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Vanadium and Compounds. 1992.
2. Hoffman, D.J., "Embryotoxic Effects of Crude Oil Containing Nickel and Vanadium in Mallards." Bull. Environm. Contam. Toxicol. 23, 203-206, 1973.
3. Hafez, Y.S., and F. H. Kratzer "The Effect of Pharmacological Levels of Dietary Vanadium on the Egg Production, Shell Thickness and Egg Yolk Cholesterol in Laying Hens and Coturnix." Poultry Sci. Vol 55, pgs. 923-926, 1976.
4. Hansard, II, S.L., Ammerman, C.B., Henry, P.R., and C.F. Simpson. "Vanadium Metabolism in Sheep. I. Comparative and Acute Toxicity of Vanadium Compounds in Sheep." Journal of Animal Science Vol. 55, No. 2, 1982.

Table J-78
Ecological Toxicity Profile for Vinyl Acetate

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Vinyl Acetate						
Rat		Inhalation	4 hours	Death	LC_{50} = 3680 ppm	1
Rat		Inhalation	GD 6-15	Reduced fetal growth	LOAEL = 1000 ppm	1
Mouse		Oral - water	3 months, 7 days/week	Decreased testes weight	LOAEL = 38 mg/kg/day	1
Flounder		Medium - saltwater	48 hours	Death	LC_{50} > 1000 ppm	2
Protozoa (*Uronema parduczi*)				Cell multiplication inhibition test	Toxicity threshold = 81 mg/L	2
Algae (*Microcystis aeruginosa*)				Cell multiplication inhibition test	Toxicity threshold = 35 mg/L	2
Green algae (*Scenedesmus quadricauda*)				Cell multiplication inhibition test	Toxicity threshold = 370 mg/L	2

The primary use for vinyl acetate is the production of polyvinyl acetate and polyvinyl alcohol. Polyvinyl acetate emulsions, the major derivatives of vinyl acetate, are widely used in adhesives for packaging and construction. Vinyl acetate is released to the environment, principally to the atmosphere, as a result of emissions from manufacturing, processing and storage facilities. Vinyl acetate partitions to the atmosphere and to surface water and groundwater. The compound is transformed by photochemical oxidation in the atmosphere, and by hydrolysis and biodegradation in surface waters, groundwater and soils. As a result of its low K_{ow} , high vapor pressure, and high water solubility, vinyl acetate should not bioaccumulate in terrestrial or aquatic organisms or biomagnify in food chains. (2).

Bioconcentration Factor (BCF), estimated = 6.09

Environmental Fate:
- Henry's law constant = 4.7×10^{-4} atm-m^3/mole
- Solubility in water at 20°C = 2 g/100 ml
- Log K_{ow} = 1.50

References:

1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Vinyl Acetate. 1990
2. Hazardous Substance Data Baxe (HSDB). On-line Computer Database. U.S. Department of Health and Human Services, Bethesda, MD. 1995

Table J-79
Ecological Toxicity Profile for Vinyl Chloride

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Vinyl Chloride						
Rat		Inhalation	12 months 6 days/week 6 hours/day	Testes necrosis	LOAEL = 100 ppm	1
Mouse		Inhalation	12-18 months 5 days/week 6 hours/day	Liver and lung cancer	LOAEL (Cancel Effect Level) = 50 ppm	1
Rat		Oral - food	2 years 5 days/week 4 hours/day	Death	LOAEL = 5.6 mg/kg/day	1
Rat		Oral -food	3 years	Decreased survival	LOAEL = 1.7 mg/kg/day	1
Rat		Oral - food	2 years 5 days/week 4 hours/day	Liver cancer	LOAEL (Cancer Effect Level) = 1.8 mg/kg/day	1
Northern Pike (*Esox lucius*)		Medium-renewal	10 days		EC_{100} = 388 mg/L	2

Vinyl chloride is used in the plastics industry in the construciton of PVC. It does not occur naturally but is released into the environment through manufacturing effluents and emissions. Vinyl chloride is expected to be highly mobile in soil and is likely to leach into groundwater. Bioconcentration is expected to be limited in aquatic organisms due to a BCF of 5.1 based on regression analysis.

Environmental Fate:
- Log K_{ow} = 1.36
- Log K_{oc} = 1.99
- Vapor Pressure at 20°C - 2,530 mmHg
- Henry's Law Constant at 10°C = 1.2 atm m^3/moL

References:
1. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Vinyl Chloride, 1993.
2. Aquatic Information Retrieval (AQUIRE), 1994, On-Line Computer Database: Chemical Information Systems, Inc., Baltimore, Md.

Table J-80
Ecological Toxicity Profile for Xylenes

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Xylenes						
Cat	o-Xylene	Oral	Single dose	Death	LD_{50} = 0.1 g/kg	1
Dog	o-Xylene	Oral	Single dose	Death	LD_{50} = 0.5 g/kg	1
Trout	o-Xylene	Oral	24 hrs	Death	LC_{50} = 5.6 - 11.3 mg/L	1
Cat	o-Xylene	Oral	Single dose	Not reported	LD_{Lo} = 80 mg/kg	2
Rabbit	o-Xylene	Oral	Single dose	Not reported	LD_{Lo} = 420 mg/kg	3
Frog	o-Xylene	Subcutaneou s	Single dose	Not reported	LD_{Lo} = 75 mg/kg	2
Frog	o-Xylene	Oral	Single dose	Peripheral nerve paralysis; convulsions	LD_{Lo} = 290 mg/kg	4
Rat	o-Xylene	Oral	Single dose	Fetal death	TD_{Lo} = 300 mg/kg	5
Rat	o-Xylene	Oral	Single dose	Fetotoxicity	TD_{Lo} = 1200 mg/kg	5
Mouse	o-Xylene	Oral	Single dose	Fetal death	TD_{Lo} = 2300 mg/kg	5
Mouse	o-Xylene	Oral	Single dose	Fetotoxicity	TD_{Lo} = 2600 mg/kg	5
Mouse	o-Xylene	Oral	28 days	Degenerative central nervouse system changes. Decreased immune response.	TD_{Lo} = 174 mg/kg	6
Rat	o-Xylene	Inhalation	GD 7-14	Skeletal retardation	LOAEL = 35 ppm	7
Rat	o-Xylene	Inhalation	GD 7-14, 24 hrs/day	Decrease in fetal weight	LOAEL = 350 ppm	7

Table J-80
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Xylenes						
Rat	*p*-xylene	Inhalation	24-48 hours GD 9,10	27% reduction in fetal weight	LOAEL = 691 ppm	7
Rat	*p*-xylene	Inhalation	24-48 hours; GD 9	7% decrease in fetal weight	LOAEL = 691 ppm	7
Rat	*p*-xylene	Inhalation	24 hours a day for 8 days; GD 7-14	Skeletal retardation signs	LOAEL = 35 ppm	7
Rat	*p*-xylene	Inhalation	6 hours a day for 10 days; GD 7-16	Developmental	NOAEL = 1,612 ppm	7
Rat	*m*-xylene	Inhalation	24 hours a day for 8 days; GD 7-14	Developmental	NOAEL = 35 ppm	7
Mouse	*m*-xylene	Gavage - oil	Once a day for 5 days; GD 8-12	Developmental	NOAEL = 2,000 mg/kg/day	7
Rat	*m*-xylene	Gavage - oil	Once a day, 7 days a week, for 13 weeks	Reproductive	NOAEL = 800 mg/kg/day	7
Rat	*p*-xylene	Gavage - oil	Once a day, 7 days a week, for 13 weeks	Reproductive	NOAEL = 800 mg/kg/day	7
Meadow vole	Mixed isomers				NOAEL =1.82 mg/kg/day	8
Red fox	Mixed isomers				NOAEL = 0.394 mg/kg/day	8
Terrestrial plants	Mixed isomers	Soil		20% reduction in plant growth	LOEC = 100 mg/L	8
Goldfish	Mixed isomers		24 hours	Death	LD_{50} = 13 mg/L	9

Table J-80
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Xylenes						
Rainbow trout	Mixed isomers		96 hours	Death	LC_{50} = 13.5 mg/L	9
Fathead minnow	Mixed isomers	Medium - static	1 hour	Death	LC_{50} = 46 mg/L	9

Xylenes are used primarily in the production of ethylbenzene. Other uses include industrial solvents, gasoline blends, and intermediates of reactions. They are released to the air primarily as fugitive emissions, dust from industrial sources, and automobile exhaust. Xylenes are released to soil and water primarily by spills. They tend to absorb to organic matter as indicated by a log Kow for *o*-xylene of 2.77 and 3.15 for *p*-xylene. The log K_{oc} has been estimated to be 2.11 for *o*-xylene and 2.31 for *p*-xylene. Xylene has been found to bioaccumulate modestly, but biomagnification in the food chain has not been observed. A bioconcentration factor of 105 has been determined.

Bioconcentration:
- goldfish log BCF = 1.9

Environmental fate:
- Log K_{ow} (*o*-xylene) = 2.77
- Log K_{ow} (*p*-xylene) = 3.15

References:

1. Gekkan Yaduji, vol 22, pg 883, 1980.
2. Abdernalden's Handb Biol Arb, vol 4, pg 1319, 1935.
3. J Pharmacol Exp Ther, vol 80, pg 233, 1944.
4. Naunyn-Schmiedebergs Arch Exp Pathol Pharmakol, vol 166, pg 437, 1932.
5. Natl Tech Inf Serv[PB83-247726]
6. Eur J Pharmacol Environ Toxicol Pharmacol Sect, vol 228, pg 107, 1992.
7. Agency for Toxic Substances and Disease Registry (ATSDR) Toxicological Profile for Xylenes. 1993.
8. Screening Benchmark for Ecological Risk Assessment. Environmental Sciences & Health Sciences Research Division. Oak Ridge National Labs. Oak Ridge, TN. 1994.
9. Hazardous Substances Data Base (HSDB). On-line Computer Database. U.S. Department of Health and Human Services, Bethesda, MD. 1995.

Table J-81
Ecological Toxicity Profile for Zinc

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Zinc						
Rat		gavage as Zn acetate	one time	death	LD_{50} = 237 mg/kg/day	1
Mouse		gavage as Zn sulfate	one time	death	LD_{50} = 337 mg/kg/day	1
Mouse		oral-food as Zn oleate	9 months	severe anemia	LOAEL = 68 mg/kg/day	1
Rat		oral-food as Zn sulfate	13 weeks	decreased hematocrit, WBC	LOAEL = 565 mg/kg/day	1
Cow		oral-food as Zn oxide	5 weeks	decreased body weight gain	LOAEL = 91 mg/kg/day	1
Rat		oral-food as Zn oxide	gestation days 1-15	decreased fetal weight	LOAEL = 200 mg/kg/day	1
Rat		oral-food as Zn oxide	150 days	increased still birth	LOAEL = 250 mg/kg/day	1
Rat		oral-food as Zn carbonate	150 days	no reproduction in females	LOAEL = 250 mg/kg/day	1
Marbled Salamander (embryo)	2,380 ppb		8 days	50% dead or deformed		
Turkey (Sperm)	90 mg/L	medium		fertilizing ability reduced		2
Horse	> 90 mg/kg BW	environmental		decreased growth, lameness, bone deformities, death		2
Cat	300 mg/kg	oral-food	16 weeks	weight loss, pancreas histopathology		2
Bluegill		medium	96 hour - soft water	death	LC_{50} = 1.9 - 3.6 ppm	3

Table J-81
(Continued)

Organism	Dose	Exposure Route	Exposure Period	Effect	Endpoint	Reference
Zinc						
Fathead minnow		medium		death	LC_{50} = 2.65 mg/L	4
Fladfish (*Jordanella floridae)*		Medium	96 hour	Growth of females	EC_{50} = 51 µg/L	5
Freshwater aquatic organism	110 µg/L		Chronic		AWQC - protective of aquatic life	6
Saltwater aquatic organism	86 µg/L		Chronic		AWQC - protective of aquatic life	6
Meadow vole					NOAEL = 317.9 mg/kg/day	7
Red fox					NOAEL = 68.88	7
Terrestrial plant	50 mg/kg in soil		20% reduction in growth			7

Table J-81
(Continued)

Zinc is widely distributed in nature, but is usually not found as elemental zinc in nature. In 1989, approximately 278,900 metric tons were produced from domestic ores in the United States. Zinc is used most commonly as a protective coating of other metals. In addition, it is used in alloys such as bronze and brass, for electrical apparatus. Alloys containing zinc and copper are used to make U.S. one-cent coins. Zinc salts have numerous applications and are used in wood preservation, catalysts, photographic paper, ceramics, textiles, smoke bombs, and pharmaceutical applications (1). Major sources of anthropogenic zinc in the environment include electroplaters, smelting and ore processors, mine drainage, domestic and industrial sewage, combustion of solid wastes and fossil fuels, road surface runoff, corrosion of zinc alloys and galvanized surfaces, and erosion of agricultural soils (2).

Zinc is capable of forming complexes with a variety of organic and inorganic complexing groups. Biological activity can affect the mobility of zinc in the aquatic environment, although the biota are a minor reservoir of zinc, relative to the sediments. Zinc has its primary effect on zinc-dependent enzymes that regulate RNA and DNA. The pancreas and bone are primary targets in birds and mammals. Zinc and its compounds induce testicular sarcomas in birds and rodents when injected directly into the testes; however, zinc in not carcinogenic by any other route. Growth of animal tumors is stimulated by zinc and retarded by zinc deficiency. Although tissue residues are not yet reliable indicators of zinc concentrations, zinc poisoning usually occurs in birds when liver or kidney contains > 2.1 g Zn/kg DW and in mammals when concentrations exceed 274 mg Zn/kg DW in kidneys, 465 mg Zn/kg DW in liver or 752 mg Zn/kg DW in pancreas (2).

Bioconcentration:

BCF (terrestrial plants) = 0.4
BCF (invertebrates) = 8
BCF (mammals) = 0.6
BCF (12 aquatic species) = 4 - 24,000 (1)

References:

1. Agency for Toxic Substances and Disease Registry. (ATSDR). Toxicological Profile for Zinc. 1992.
2. Eisler, R. Zinc Hazards to Fish, Wildlife, and Invertebrates: A synoptic Review. U.S. Dept of the Interior, Fish and Wildlife Service, Washington D.C., Biol Report 10, April 1993.
3. Dhar, S.K. (Editor). Metal Ions in Biological Systems. Plenum Press. New York, 1973.
4. Toussaint, M.W., Shedd, T.R., VanDerSchalie, W.H., and G.R. Leather. "A Comparison of Standard Acute Toxicity Tests with Rapid-Screening Toxicity Tests." Env. Tox. Chem. 14(5): 907-915, 1995.
5. Spehar, R.L. "Cadmium and Zinc Toxicology to Flagfish, *Jordanella floridae*." J. Fish Res Board. Can 33: 1939-1945, 1975.
6. U.S. Environmental Protection Agency (EPA), 1991, Water Quality Criteria Summary: Office of Science and Technology, Health, and Ecological Criteria Division, Washington, D.C. May.
7. Screening Benchmarks for Ecological Risk Assessment. Environmental Sciences and Health Sciences Research Division, Oak Ridge National Labs, Oak Ridge, TN, 1994.

APPENDIX K

Ecological Assessment Spreadsheets

APPENDIX K
LIST OF TABLES

APPENDIX K
LIST OF TABLES (Continued)

APPENDIX K
LIST OF TABLES (Continued)

Table K-1
Fire Protection Training Area
Ecological Quotients for the Northern Pike from Discharged Groundwater

Chemical	Conc in Water mg/L	Toxicity Data mg/L	Reference	Uncert. Factor	Toxicity Benchmark	Total EQ
1,2-Dichloroethane	5.35E-06	20	AWQC	1	20	2.67E-07
4,4'-DDT	1.05E-07	0.000001	AWQC	1	0.000001	1.05E-01
alpha-BHC	2.03E-08	0.032	EC-guppy	10000	0.0000032	6.33E-03
Benzene	4.12E-06	5.3	AWQC	10	0.53	7.78E-06
beta-BHC	3.11E-08	0.032	EC-guppy	10000	0.0000032	9.73E-03
Bromochloromethane	2.71E-04	a	a	a	a	a
Chloromethane	2.30E-09	27	LC50-silverside	10000	0.0027	8.52E-07
Dibromomethane	8.30E-10	a	a	a	a	a
Dieldrin	2.55E-08	0.0000019	AWQC	1	0.0000019	1.34E-02
Ethylbenzene	1.83E-07	42.3	LC100-minnow	1000	0.0423	4.33E-06
gamma-BHC	2.83E-08	0.023	LC50-salmon	1000	0.000023	1.23E-03
Heptachlor	2.03E-45	0.0000038	AWQC	1	0.0000038	5.34E-40
Heptachlor epoxide	2.98E-08	0.0000038	AWQC	1	0.0000038	7.85E-03
Lead	6.58E-05	0.0032	AWQC	1	0.0032	2.06E-02
Methoxychlor	2.05E-07	0.0003	AWQC	1	0.0003	6.82E-04
Toluene	3.51E-13	17.5	AWQC	10	1.75	2.01E-13
Xylene (total)	4.20E-06	13.5	LC50-trout	100	0.135	3.11E-05

a = no toxicity information available

EQ pike =concentration in water/toxicity benchmark
Concentration in water = modeled groundwater concentrations at a 5-feet range from shoreline (see Appendix C)

Table K-2
Fire Protection Training Area
Ecological Quotients for Aquatic Invertebrates at the Mudflats

Chemical	Conc in Water mg/L	Toxicity Data mg/L	Reference	Uncert. Factor	Toxicity Benchmark	Total EQ
1,2-Dichloroethane	0.001035	20	AWQC	1	20	5.17E-05
4,4'-DDT	2.04E-05	0.000001	AWQC	1	0.000001	2.04E+01
alpha-BHC	3.92E-06	0.1	EC50-Daphnia	100	0.001	3.92E-03
Benzene	0.000798	5.3	AWQC-LOEL	10	0.53	1.50E-03
beta-BHC	6.02E-06	0.1	EC50-Daphnia	100	0.001	6.02E-03
Bromochloromethane	0.05252	a	a	a	a	a
Chloromethane	4.45E-07	27	LC50-fish	100000	0.00027	1.65E-03
Dibromomethane	1.61E-07	a	a	a	a	a
Dieldrin	4.93E-06	0.0000019	AWQC	1	0.0000019	2.60E+00
Ethylbenzene	3.55E-05	275	LC50-Shrimp	100000	0.00275	1.29E-02
gamma-BHC	5.48E-06	0.46	LC48-Daphnia	100	0.0046	1.19E-03
Heptachlor	3.93E-43	0.0000038	AQWC	1	0.0000038	1.03E-37
Heptachlor epoxide	5.78E-06	0.0000038	AQWC	1	0.0000038	1.52E+00
Lead	0.012732	0.0032	AWQC	1	0.0032	3.98E+00
Methoxychlor	3.96E-05	0.0003	AWQC	1	0.0003	1.32E-01
Toluene	6.8E-11	17.5	AWQC-LOEL	10	1.75	3.89E-11
Xylene (total)	0.000813	13	LC50-fish	100000	0.00013	6.25E+00

a = no toxicity data available

EQ invertebrate = Concentration in water/toxicity benchmark
Concentration in water = modeled groundwater concentrations discharging to the shoreline (see Appendix C)

Table K-3
Fire Protection Training Area
Ecological Quotients for the Spotted Sandpiper at the Mudflats

Chemical	Conc in Water mg/L	Invert Uptake Factor	Conc in Invert mg/kg	SSP Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert. Factor	Toxicity Benchmark	% EQ Water	% EQ Invert.	Total EQ
1,2-Dichloroethane	0.0010349	2	0.00207	3.99E-03	46.81	NOAEL-robin	10	4.681	98.21	1.79	8.52E-04
4,4'-DDT	2.037E-05	12000	0.244465	8.50E-03	0.00032	NOAEL-heron	10	0.000032	0.91	99.09	2.66E+02
alpha-BHC	3.92E-06	1100	0.004312	1.63E-04	0.226	NOAEL-heron	10	0.0226	9.08	90.92	7.23E-03
Benzene	0.0007975	4.27	0.003406	3.14E-03	23.23	NOAEL-vole	10	2.323	96.26	3.74	1.35E-03
beta-BHC	6.025E-06	1460	0.008796	3.26E-04	0.226	NOAEL-heron	10	0.0226	7.00	93.00	1.44E-02
Bromochloromethane	0.0525202	a	a	a	a	a	a	a	a	a	a
Chloromethane	4.453E-07	2.88	1.28E-06	1.73E-06	500	LOAEL-mouse	100	5	97.44	2.56	3.46E-07
Dibromomethane	1.606E-07	a	a	a	a	a	a	a	a	a	a
Dieldrin	4.933E-06	2700	0.013318	4.78E-04	0.045	NOAEL-heron	10	0.0045	3.91	96.09	1.06E-01
Ethylbenzene	3.546E-05	144	0.005106	3.10E-04	3500	LD50-rat	10000	0.35	43.27	56.73	8.86E-04
gamma-BHC	5.482E-06	319	0.001749	8.10E-05	4.66	NOAEL-robin	10	0.466	25.61	74.39	1.74E-04
Heptachlor	3.93E-43	20	7.86E-42	1.76E-42	92	LC50-quail	10000	0.0092	84.59	15.41	1.91E-40
Heptachlor epoxide	5.775E-06	20	0.000116	2.58E-05	92	LC50-quail	10000	0.0092	84.59	15.41	2.81E-03
Lead	0.0127322	42	0.534751	6.66E-02	100	Dose-gull	10000	0.01	72.34	27.66	6.66E+00
Methoxychlor	3.959E-05	113	0.004473	3.04E-04	2000	LD50-mallard	10000	0.2	49.29	50.71	1.52E-03
Toluene	6.801E-11	90	6.12E-09	4.68E-10	22.9	NOAEL-vole	10	2.29	54.96	45.04	2.04E-10
Xylene (total)	0.0008131	80	0.065049	5.32E-03	1.82	NOAEL-vole	10	0.182	57.86	42.14	2.92E-02

Spotted Sandpiper Constants:	
Body weight - BW (kg)	0.047
Water Intake - WI (Liters/day)	0.67
Food Ingestion rate-FI (kg/day)	0.00744
Soil Ingestion fraction - SI	0.18
Food Ingestion fraction - FI	0.82
Home Range (acres)	2.5
Time on site (months)	5
Home Range Fraction -HR	0.632

a = no toxicity data available

EQ = sandpiper intake/toxicity benchmark

Intake = (HR/BW) x 0.42 x ((Conc in Invert x FI x FF) + (Conc in water x WI))

Con. in Water = modeled groundwater concentrations discharged to the mudflats (see Appendix C)

Table K-4
Fire Protection Training Area
Ecological Quotients for Terrestrial Plants

Chemical	Conc in Soil mg/kg	Tox Data mg/kg	Reference	Uncert. Factor	Toxicity Benchmark	Ecological Quotients
1,1,1-Trichloroethane	0.0010	a	a	a	a	a
1,1,2,2-Tetrachloroethane	0.1670	a	a	a	a	a
2-Butanone (MEK)	3.6664	a	a	a	a	a
2-Hexanone	2.4221	a	a	a	a	a
4,4'-DDD	0.0912	a	a	a	a	a
4,4'-DDE	0.0257	a	a	a	a	a
4,4'-DDT	0.4388	a	a	a	a	a
Acenaphthene	0.0204	a	a	a	a	a
Acenaphthylene	0.1447	a	a	a	a	a
Aldrin	0.0094	a	a	a	a	a
alpha-BHC	0.0019	a	a	a	a	a
Anthracene	1.5766	a	a	a	a	a
Benz(a)anthracene	0.0152	a	a	a	a	a
Benzene	0.0114	a	a	a	a	a
Benzo(a)pyrene	0.0173	a	a	a	a	a
Benzo(b)fluoranthene	0.0202	a	a	a	a	a
Benzo(g,h,i)perylene	0.0738	a	a	a	a	a
Benzo(k)fluoranthene	0.0092	a	a	a	a	a
beta-BHC	0.0023	a	a	a	a	a
Bromodichloromethane	0.3049	a	a	a	a	a
Cadmium	0.6028	3	LOEC	1	3	2.01E-01
Chlorobenzene	0.0460	a	a	a	a	a
Chrysene	0.0073	a	a	a	a	a
delta-BHC	0.0053	a	a	a	a	a
Dibenz(a,h)anthracene	0.0014	a	a	a	a	a
Dieldrin	0.0017	a	a	a	a	a
Endosulfan I	0.0070	a	a	a	a	a
Endosulfan II	0.0052	a	a	a	a	a
Endrin	0.0041	a	a	a	a	a
Endrin aldehyde	0.0028	a	a	a	a	a
Fluoranthene	0.0037	a	a	a	a	a
Fluorene	0.9656	a	a	a	a	a
gamma-BHC	0.0013	a	a	a	a	a
Heptachlor	0.0011	a	a	a	a	a
Heptachlor epoxide	0.0031	a	a	a	a	a
HpCDD Totals	0.0001	a	a	a	a	a
Indeno(1,2,3-cd)pyrene	0.0204	a	a	a	a	a
Lead	59.9168	a	a	a	a	a
Methoxychlor	0.0010	a	a	a	a	a
Methylene chloride	0.1013	a	a	a	a	a
Naphthalene	3.2046	a	a	a	a	a
OCDD	0.0007	a	a	a	a	a
Phenanthrene	8.0825	a	a	a	a	a
Pyrene	0.2792	a	a	a	a	a
Toluene	0.1037	200	LOEC	1	200	5.18E-04
Vinyl acetate	9.0891	a	a	a	a	a
Xylene (total)	27.9890	50	LOEC	1	50	5.60E-01

a = No toxicity data available
EQ plant = Concentration in soil/toxicity benchmark

Table K-5
Fire Protection Training Area
Ecological Quotients for the Meadow Vole

Chemical	Conc in Soil mg/kg	log Kow	Plant Uptake Factor	Conc in Plants mg/kg	MV Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Plant	Total EQ
1,1,1-Trichloroethane	0.0010	2.49	1.408575	1.42E-03	1.78E-04	750	LOAEL-rat	60	12.5	1.72	98.28	1.42E-05
1,1,2,2-Tetrachloroethane	0.1670	2.39	1.609089	2.69E-01	3.34E-02	1.23	NOAEL -vole	1	1.23	1.51	98.49	2.72E-02
2-Butanone (MEK)	3.6664	0.29	26.3257	9.65E+01	1.18E+01	1080	LOAEL-rat	60	18	0.09	99.91	6.58E-01
2-Hexanone	2.4221	1.48	5.402067	1.31E+01	1.61E+00	660	LOAEL-rat	60	11	0.45	99.55	1.47E-01
4,4'-DDD	0.0912	6.2	0.010102	9.21E-04	3.88E-04	1.58	NOAEL -vole	1	1.58	70.88	29.12	2.46E-04
4,4'-DDE	0.0257	7	0.003483	8.96E-05	8.85E-05	1.58	NOAEL -vole	1	1.58	87.59	12.41	5.60E-05
4,4'-DDT	0.4388	6.19	0.010237	4.49E-03	1.87E-03	1.58	NOAEL -vole	1	1.58	70.61	29.39	1.19E-03
Acenaphthene	0.0204	3.92	0.21001	4.29E-03	5.87E-04	2	dose-rat	6000	0.00033333	10.48	89.52	1.76E+00
Acenaphthylene	0.1447	4.07	0.172005	2.49E-02	3.49E-03	1700	LD50-rat	6000	0.28333333	12.51	87.49	1.23E-02
Aldrin	0.0094	5.68	0.020182	1.90E-04	5.18E-05	0.396	NOAEL -vole	1	0.396	54.92	45.08	1.31E-04
alpha-BHC	0.0019	3.46	0.387365	7.51E-04	9.79E-05	3.17	NOAEL-vole	1	3.17	5.97	94.03	3.09E-05
Anthracene	1.5766	4.45	0.103729	1.64E-01	2.48E-02	430	LD50-rodent	6000	0.07166667	19.16	80.84	3.46E-01
Benz(a)anthracene	0.0152	5.6	0.022449	3.42E-04	8.79E-05	2	Dose-rodent	6000	0.00033333	52.28	47.72	2.64E-01
Benzene	0.0114	2.13	2.274364	2.59E-02	3.21E-03	23.23	NOAEL-vole	1	23.23	1.07	98.93	1.38E-04
Benzo(a)pyrene	0.0173	6.19	0.010237	1.77E-04	7.37E-05	10	LD50-rodent	6000	0.00166667	70.61	29.39	4.42E-02
Benzo(b)fluoranthene	0.0202	6.06	0.012171	2.45E-04	9.09E-05	40	dose-rodent	6000	0.00666667	66.89	33.11	1.36E-02
Benzo(g,h,i)perylene	0.0738	6.5	0.006776	5.00E-04	2.84E-04	0.8	dose-mouse	6000	0.00013333	78.40	21.60	2.13E+00
Benzo(k)fluoranthene	0.0092	6.06	0.012171	1.12E-04	4.14E-05	72	dose-mouse	6000	0.012	66.89	33.11	3.45E-03
beta-BHC	0.0023	4.5	0.097051	2.21E-04	3.40E-05	3.17	NOAEL-vole	1	3.17	20.22	79.78	1.07E-05
Bromodichloromethane	0.3049	a	a	a	a	a	a	a	a	a	a	a
Cadmium	0.6028	b	0.121	7.29E-02	1.08E-02	19.7	NOAEL-rat	6	3.28333333	16.89	83.11	3.28E-03
Chlorobenzene	0.0460	2.84	0.884056	4.07E-02	5.13E-03	120	LOAEL-rat	60	2	2.71	97.29	2.56E-03
Chrysene	0.0073	5.6	0.022449	1.65E-04	4.23E-05	99	dose-rodent	6000	0.0165	52.28	47.72	2.57E-03
delta-BHC	0.0053	2.8	0.932395	4.96E-03	6.24E-04	3.17	NOAEL-vole	1	3.17	2.57	97.43	1.97E-04
Dibenz(a,h)anthracene	0.0014	6.83	0.004368	6.30E-06	5.12E-06	5	dose-rat	6000	0.00083333	84.92	15.08	6.14E-03
Dieldrin	0.0017	4.32	0.123322	2.05E-04	3.01E-05	0.04	NOAEL-vole	1	0.04	16.62	83.38	7.52E-04
Endosulfan I	0.0070	3.83	0.236734	1.66E-03	2.25E-04	0.29	NOAEL-vole	1	0.29	9.41	90.59	7.74E-04
Endosulfan II	0.0052	3.52	0.357635	1.86E-03	2.44E-04	0.29	NOAEL-vole	1	0.29	6.43	93.57	8.42E-04
Endrin	0.0041	5.33	0.032156	1.31E-04	2.84E-05	0.081	NOAEL-vole	1	0.081	43.33	56.67	3.51E-04
Endrin aldehyde	0.0028	3.14	0.593035	1.67E-03	2.13E-04	0.081	NOAEL-vole	1	0.081	3.98	96.02	2.63E-03
Fluoranthene	0.0037	4.89	0.057754	2.15E-04	3.76E-05	2000	dose-rat	6000	0.33333333	29.86	70.14	1.13E-04
Fluorene	0.9656	4.17	0.150571	1.45E-01	2.07E-02	8.6	dose-rat	6000	0.00143333	14.04	85.96	1.45E+01
gamma-BHC	0.0013	3.3	0.479292	6.14E-04	7.92E-05	15.8	NOAEL-vole	1	15.8	4.88	95.12	5.01E-06
Heptachlor	0.0011	5.44	0.027777	2.97E-05	6.86E-06	1.58	NOAEL-vole	1	1.58	46.96	53.04	4.34E-06
Heptachlor epoxide	0.0031	5.4	0.029295	8.95E-05	2.02E-05	1.58	NOAEL-vole	1	1.58	45.63	54.37	1.28E-05
HpCDD Totals	0.0001	8.2	0.000705	7.50E-08	3.30E-07	0.006	LD50-Gpig	6000	0.000001	97.21	2.79	3.30E-01

Table K-5
Fire Protection Training Area
Ecological Quotients for the Meadow Vole

Chemical	Conc in Soil mg/kg	log Kow	Plant Uptake Factor	Conc in Plants mg/kg	MV Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Plant	Total EQ
Indeno(1,2,3-cd)pyrene	0.0204	6.5	0.006776	1.38E-04	7.84E-05	72	dose-rodent	6000	0.012	78.40	21.60	6.54E-03
Lead	59.9168	b	0.045	2.70E+00	5.11E-01	15.86	NOAEL-vole	1	15.86	35.34	64.66	3.22E-02
Methoxychlor	0.0010	5.08	0.04485	4.31E-05	8.17E-06	60	LOAEL-rat	60	1	35.41	64.59	8.17E-06
Methylene chloride	0.1013	0.95	10.93705	1.11E+00	1.36E-01	11.59	NOAEL-vole	1	11.59	0.22	99.78	1.18E-02
Naphthalene	3.2046	3.29	0.485713	1.56E+00	2.01E-01	1780	LD50-rodent	6000	0.29666667	4.82	95.18	6.76E-01
OCDD	0.0007	7.59	0.001588	1.04E-06	2.10E-06	0.006	LD50-Gpig	6000	0.000001	93.93	6.07	2.10E+00
Phenanthrene	8.0825	4.38	0.113857	9.20E-01	1.37E-01	700	dose-mouse	6000	0.11666667	17.76	82.24	1.18E+00
Pyrene	0.2792	4.9	0.05699	1.59E-02	2.79E-03	800	LD50-mouse	6000	0.13333333	30.14	69.86	2.10E-02
Toluene	0.1037	2.69	1.079394	1.12E-01	1.40E-02	22.9	NOAEL-vole	1	22.9	2.23	97.77	6.13E-04
Vinyl acetate	9.0891	1.5	5.260173	4.78E+01	5.89E+00	38	LOAEL-mouse	60	0.63333333	0.47	99.53	9.30E+00
Xylene (total)	27.9890	4.9	0.05699	1.60E+00	2.80E-01	1.82	NOAEL-vole	1	1.82	30.14	69.86	1.54E-01

Meadow Vole constants:		
Food Ingestion Rate (FI):	kg/day	0.0049
Soil Ingestion Fraction (S):	unitless	0.024
Water Ingestion Rate (WI):	L/day	0.0053
Food Ingestion Fraction (F):	unitless	0.976
Body Weight (BW):	kg	0.039
Home Range:	acres	0.34
Site Area:	acres	1.58
Home Range Fraction (HR):	unitless	1

a = No toxicity data available
b= Kow not applicable to metals

EQ vole = vole intake/toxicity benchmark
Vole intake = (HR/BW) x [(Conc in plants x FI x F) + (Conc in soil x FI x S)]
Conc in plants = Conc in soil x plant uptake factor

Table K-6
Fire Protection Training Area
Ecological Quotients for the Red Fox

Chemical	Conc in Soil mg/kg	MV BAF	Conc in MVs mg/kg	Red Fox Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ MV	Total EQ
1,1,1-Trichloroethane	0.001011	9	1.60E-03	7.21E-08	201.40	NOAEL-red fox	1	201.4000	1.79	98.21	3.58E-10
1,1,2,2-Tetrachloroethane	0.166954	21	7.02E-01	3.13E-05	0.27	NOAEL-red fox	1	0.2680	0.68	99.32	1.17E-04
2-Butanone (MEK)	3.666419	0.98	1.16E+01	5.19E-04	2737.00	LD50-rat	10000	0.2737	0.90	99.10	1.89E-03
2-Hexanone	2.422059	7	1.13E+01	5.03E-04	660.00	LOAEL-rat	100	6.6000	0.61	99.39	7.61E-05
4,4'-DDD	0.091184	5	1.94E-03	2.02E-07	0.34	NOAEL-red fox	1	0.3440	57.52	42.48	5.88E-07
4,4'-DDE	0.025713	5	4.43E-04	5.24E-08	0.34	NOAEL-red fox	1	0.3440	62.60	37.40	1.52E-07
4,4'-DDT	0.438756	5	9.37E-03	9.74E-07	0.34	NOAEL-red fox	1	0.3440	57.43	42.57	2.83E-06
Acenaphthene	0.020407	0.34	2.00E-04	3.49E-08	8.00	LD50-rat	10000	0.0008	74.65	25.35	4.36E-05
Acenaphthylene	0.144746	0.34	1.19E-03	2.37E-07	1700.00	LD50-rat	10000	0.1700	77.85	22.15	1.39E-06
Aldrin	0.009427	8	4.14E-04	3.04E-08	0.09	NOAEL-red fox	1	0.0860	39.61	60.39	3.53E-07
alpha-BHC	0.001938	4.2	4.11E-04	2.07E-08	0.01	NOAEL-red fox	1	0.0080	11.95	88.05	2.58E-06
Anthracene	1.576619	0.34	8.43E-03	2.38E-06	430.00	LD50-mouse	10000	0.0430	84.34	15.66	5.54E-05
Benz(a)anthracene	0.015243	0.125	1.10E-05	1.99E-08	2.00	dose-rodent	10000	0.0002	97.56	2.44	9.96E-05
Benzene	0.011377	24	7.70E-02	3.42E-06	5.04	NOAEL-red fox	1	5.0400	0.42	99.58	6.79E-07
Benzo(a)pyrene	0.017255	0.342	2.52E-05	2.31E-08	10.00	dose-mouse	10000	0.0010	95.17	4.83	2.31E-05
Benzo(b)fluoranthene	0.020167	0.32	2.91E-05	2.70E-08	40.00	dose-rodent	10000	0.0040	95.23	4.77	6.75E-06
Benzo(g,h,i)perylene	0.073787	0.34	9.65E-05	9.84E-08	0.80	dose-mouse	10000	0.0001	95.66	4.34	1.23E-03
Benzo(k)fluoranthene	0.009184	0.34	1.41E-05	1.23E-08	72.00	dose-rodent	10000	0.0072	94.95	5.05	1.71E-06
beta-BHC	0.002277	4.2	1.43E-04	9.22E-09	0.17	NOAEL-red fox	1	0.1720	31.50	68.50	5.36E-08
Bromodichloromethane	0.304925	a	a	a	a	a	a	a	a	a	a
Cadmium	0.602768	21	2.26E-01	1.08E-05	19.70	NOAEL-rat	10	1.9700	7.14	92.86	5.47E-06
Chlorobenzene	0.046022	70	3.59E-01	1.59E-05	120.00	LOAEL-rat	100	1.2000	0.37	99.63	1.33E-05
Chrysene	0.007341	0.07	2.96E-06	9.49E-09	99.00	dose-rodent	10000	0.0099	98.62	1.38	9.59E-07
delta-BHC	0.005315	4.2	2.62E-03	1.23E-07	0.01	NOAEL-red fox	1	0.0080	5.52	94.48	1.53E-05
Dibenz(a,h)anthracene	0.001441	0.34	1.74E-06	1.92E-09	0.01	dose-rodent	10000	0.0000	95.98	4.02	3.19E-03
Dieldrin	0.001659	8	2.41E-04	1.28E-08	0.01	NOAEL-red fox	1	0.0090	16.56	83.44	1.42E-06
Endosulfan I	0.007006	59	1.32E-02	5.95E-07	0.07	NOAEL-red fox	1	0.0650	1.50	98.50	9.16E-06
Endosulfan II	0.005211	59	1.44E-02	6.45E-07	0.07	NOAEL-red fox	1	0.0650	1.03	98.97	9.92E-06
Endrin	0.004085	8	2.27E-04	1.53E-08	0.02	NOAEL-red fox	1	0.0180	34.10	65.90	8.49E-07
Endrin aldehyde	0.002808	8	1.70E-03	7.89E-08	0.02	NOAEL-red fox	1	0.0180	4.54	95.46	4.38E-06
Fluoranthene	0.003720	0.08	3.00E-06	4.88E-09	2000.00	LD50-rat	10000	0.2000	97.27	2.73	2.44E-08

Table K-6
Fire Protection Training Area
Ecological Quotients for the Red Fox

Chemical	Conc in Soil mg/kg	MV BAF	Conc in MVs mg/kg	Red Fox Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ MV	Total EQ
Fluorene	0.9656	0.34	7.05E-03	1.54E-06	8.60	dose-rat	10000	0.0009	79.78	20.22	1.79E-03
gamma-BHC	0.0013	4.2	3.33E-04	1.64E-08	3.44	NOAEL-red fox	1	3.4400	9.99	90.01	4.76E-09
Heptachlor	0.0011	10	6.86E-05	4.40E-09	0.34	NOAEL-red fox	1	0.3440	30.97	69.03	1.28E-08
Heptachlor epoxide	0.0031	10	2.02E-04	1.28E-08	0.34	NOAEL-red fox	1	0.3440	30.36	69.64	3.73E-08
HpCDD Totals	0.0001	5	1.65E-06	2.09E-10	0.00	NOAEL-red fox	1	0.0001	65.00	35.00	2.98E-06
Indeno(1,2,3-cd)pyrene	0.0204	0.34	2.67E-05	2.72E-08	72.00	dose-rodent	10000	0.0072	95.66	4.34	3.78E-06
Lead	59.9168	0.42	2.15E-01	8.59E-05	3.44	NOAEL-red fox	1	3.4400	88.93	11.07	2.50E-05
Methoxychlor	0.0010	113	9.24E-04	4.21E-08	60.00	LOAEL-rat	100	0.6000	2.91	97.09	7.02E-08
Methylene chloride	0.1013	2.3	3.13E-01	1.40E-05	2.51	NOAEL-red fox	1	2.5100	0.92	99.08	5.58E-06
Naphthalene	3.2046	0.34	6.82E-02	7.10E-06	300.00	LOAEL-mouse	100	3.0000	57.52	42.48	2.37E-06
OCDD	0.0007	5	1.05E-05	1.30E-09	0.00	NOAEL-red fox	1	0.0001	64.22	35.78	1.85E-05
Phenanthrene	8.0825	0.12	1.65E-02	1.10E-05	700.00	LD50-mouse	10000	0.0700	93.39	6.61	1.58E-04
Pyrene	0.2792	0.34	9.50E-04	3.98E-07	800.00	LD50-mouse	10000	0.0800	89.44	10.56	4.98E-06
Toluene	0.1037	20	2.81E-01	1.26E-05	4.90	NOAEL-red fox	1	4.9000	1.05	98.95	2.56E-06
Vinyl acetate	9.0891	6.09	3.59E+01	1.60E-03	38.00	LOAEL-mouse	100	0.3800	0.72	99.28	4.21E-03
Xylene (total)	27.9890	1.9	5.32E-01	5.92E-05	0.39	NOAEL-red fox	1	0.3940	60.25	39.75	1.50E-04

Red Fox Constants:

Food Ingestion Rate (FI):	kg/day	0.27
Soil Ingestion Fraction (S):	unitless	0.03
Water Ingestion Rate (WI):	unitless	0.44
Food Ingestion Fraction (F):	unitless	0.97
Body Weight (BW):	kg	5.25
Home Range:	acres	1771.00
Site Area:	acres	1.58
Home Range Fraction (HR):	unitless	0.001

a = no toxicity data available
EQ red fox = red fox intake/toxicity benchmark
Red fox Intake = (HR/BW) x [(Conc in MV x FI x F) + (Conc in Soil x FI x S)]
Conc. in MV = BAF x Meadow vole intake

Table K-7
Fire Protection Training Area
Ecological Quotients for Terrestrial Invertebrates

Chemical	Conc in Soil mg/kg	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
1,1,1-Trichloroethane	0.0010	a	a	a	a	a
1,1,2,2-Tetrachloroethane	0.1670	14	EC40-daphnia	10	1.4	1.19E-01
2-Butanone (MEK)	3.6664	a	a	a	a	a
2-Hexanone	2.4221	a	a	a	a	a
4,4'-DDD	0.0912	a	a	a	a	a
4,4'-DDE	0.0257	a	a	a	a	a
4,4'-DDT	0.4388	a	a	a	a	a
Acenaphthene	0.0204	a	a	a	a	a
Acenaphthylene	0.1447	a	a	a	a	a
Aldrin	0.0094	a	a	a	a	a
alpha-BHC	0.0019	0.1	EC50-daphnia	10	0.01	1.94E-01
Anthracene	1.5766	a	a	a	a	a
Benz(a)anthracene	0.0152	a	a	a	a	a
Benzene	0.0114	27	LC50-shrimp	100	0.27	4.21E-02
Benzo(a)pyrene	0.0173	1	LC50-sandworm	10	0.1	1.73E-01
Benzo(b)fluoranthene	0.0202	a	a	a	a	a
Benzo(g,h,i)perylene	0.0738	a	a	a	a	a
Benzo(k)fluoranthene	0.0092	a	a	a	a	a
beta-BHC	0.0023	0.1	EC50-daphnia	10	0.01	2.28E-01
Bromodichloromethane	0.3049	a	a	a	a	a
Cadmium	0.6028	6.4	LC50-plankton	10	0.64	9.42E-01
Chlorobenzene	0.0460	a	a	a	a	a
Chrysene	0.0073	a	a	a	a	a
delta-BHC	0.0053	0.1	EC50-daphnia	10	0.01	5.32E-01
Dibenz(a,h)anthracene	0.0014	a	a	a	a	a
Dieldrin	0.0017	0.0011	LC50-chironomid	10	0.00011	1.51E+01
Endosulfan I	0.0070	a	a	a	a	a
Endosulfan II	0.0052	a	a	a	a	a
Endrin	0.0041	a	a	a	a	a
Endrin aldehyde	0.0028	a	a	a	a	a
Fluoranthene	0.0037	0.04	LC50-shrimp	10	0.004	9.30E-01
Fluorene	0.9656	173	LC50-earthworm	10	17.3	5.58E-02
gamma-BHC	0.0013	0.008	LC50-insect	10	0.0008	1.60E+00
Heptachlor	0.0011	0.047	LC50-daphnia	10	0.0047	2.27E-01
Heptachlor epoxide	0.0031	0.047	LC50-daphnia	10	0.0047	6.50E-01
HpCDD Totals	0.0001	a	a	a	a	a
Indeno(1,2,3-cd)pyrene	0.0204	a	a	a	a	a
Lead	59.9168	50	LOEC-plant	1000	0.05	1.20E+03
Methoxychlor	0.0010	a	a	a	a	a
Methylene chloride	0.1013	224	LC50-daphnia	10	22.4	4.52E-03
Naphthalene	3.2046	3.8	LC50-sandworm	10	0.38	8.43E+00
OCDD	0.0007	a	a	a	a	a
Phenanthrene	8.0825	6	LC50-sandworm	10	0.6	1.35E+01
Pyrene	0.2792	a	a	a	a	a
Toluene	0.1037	22	LC50-mosquito	10	2.2	4.71E-02
Vinyl acetate	9.0891	81	EC-protozoa	10	8.1	1.12E+00
Xylene (total)	27.9890	100	LOEC-plant	1000	0.1	2.80E+02

a = no toxicity information available
EQ for invertebrates = Conc in soil/toxicity benchmark

Table K-8
Fire Protection Training Area
Ecological Quotients for the Savannah Sparrow

Chemical	Conc in Soil mg/kg	Invert Uptake Factor	Conc in Invert mg/kg	Sparrow Intake mg/kg	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Invert	Total EQ
1,1,1-Trichloroethane	0.0010	9.00	9.10E-03	8.16E-04	927.3	NOAEL-vole	10	92.73	1.29	98.71	8.80E-06
1,1,2,2-Tetrachloroethane	0.1670	21.00	3.51E+00	3.12E-01	3.2	LOAEL-rat	100	0.032	0.56	99.44	9.75E+00
2-Butanone (MEK)	3.6664	0.98	3.59E+00	3.56E-01	2737	LD50-rat	10000	0.2737	10.70	89.30	1.30E+00
2-Hexanone	2.4221	7.00	1.70E+01	1.53E+00	660	LOAEL-rat	100	6.6	1.65	98.35	2.31E-01
4,4'-DDD	0.0912	5.00	4.56E-01	4.13E-02	0.00099	NOAEL-robin	1	0.00099	2.29	97.71	4.17E+01
4,4'-DDE	0.0257	5.00	1.29E-01	1.16E-02	0.00099	NOAEL-robin	1	0.00099	2.29	97.71	1.18E+01
4,4'-DDT	0.4388	5.00	2.19E+00	1.99E-01	0.00099	NOAEL-robin	1	0.00099	2.29	97.71	2.01E+02
Acenaphthene	0.0204	0.34	6.94E-03	8.26E-04	8	LD50-rat	10000	0.0008	25.66	74.34	1.03E+00
Acenaphthylene	0.1447	a	a	a	a	a	a	a	a	a	a
Aldrin	0.0094	8.00	7.54E-02	6.77E-03	6.59	LD50-bobwhite	100	0.0659	1.45	98.55	1.03E-01
alpha-BHC	0.0019	4.20	8.14E-03	7.40E-04	0.702	NOAEL-robin	1	0.702	2.72	97.28	1.05E-03
Anthracene	1.5766	a	a	a	a	a	a	a	a	a	a
Benz(a)anthracene	0.0152	a	a	a	a	a	a	a	a	a	a
Benzene	0.0114	24.00	2.73E-01	2.43E-02	930	LD50-rat	10000	0.093	0.49	99.51	2.61E-01
Benzo(a)pyrene	0.0173	0.34	5.90E-03	7.02E-04	0.881	NOAEL-vole	10	0.0881	25.55	74.45	7.96E-03
Benzo(b)fluoranthene	0.0202	a	a	a	a	a	a	a	a	a	a
Benzo(g,h,i)perylene	0.0738	a	a	a	a	a	a	a	a	a	a
Benzo(k)fluoranthene	0.0092	a	a	a	a	a	a	a	a	a	a
beta-BHC	0.0023	4.20	9.56E-03	8.70E-04	0.702	NOAEL-robin	1	0.702	2.72	97.28	1.24E-03
Bromodichloromethane	0.3049	a	a	a	a	a	a	a	a	a	a
Cadmium	0.6028	21.00	1.27E+01	1.13E+00	19.7	NOAEL-rat	10	1.97	0.56	99.44	5.72E-01
Chlorobenzene	0.0460	a	a	a	a	a	a	a	a	a	a
Chrysene	0.0073	0.07	5.14E-04	1.22E-04	99	LD50-rat	10000	0.0099	62.64	37.36	1.23E-02
delta-BHC	0.0053	4.20	2.23E-02	2.03E-03	0.702	NOAEL-robin	1	0.702	2.72	97.28	2.89E-03
Dibenz(a,h)anthracene	0.0014	a	a	a	a	a	a	a	a	a	a
Dieldrin	0.0017	8.00	1.33E-02	1.19E-03	0.139	NOAEL-robin	1	0.139	1.45	98.55	8.58E-03
Endosulfan I	0.0070	59.00	4.13E-01	3.67E-02	17.22	NOAEL-robin	1	17.22	0.20	99.80	2.13E-03
Endosulfan II	0.0052	59.00	3.07E-01	2.73E-02	17.22	NOAEL-robin	1	17.22	0.20	99.80	1.58E-03
Endrin	0.0041	8.00	3.27E-02	2.94E-03	0.73	NOAEL-robin	1	0.73	1.45	98.55	4.02E-03
Endrin aldehyde	0.0028	8.00	2.25E-02	2.02E-03	0.73	NOAEL-robin	1	0.73	1.45	98.55	2.76E-03
Fluoranthene	0.0037	0.08	2.98E-04	6.50E-05	2000	LD50-rat	10000	0.2	59.47	40.53	3.25E-04
Fluorene	0.9656	a	a	a	a	a	a	a	a	a	a
gamma-BHC	0.0013	4.20	5.38E-03	4.90E-04	4.66	NOAEL-robin	1	4.66	2.72	97.28	1.05E-04

Table K-8
Fire Protection Training Area
Ecological Quotients for the Savannah Sparrow

Chemical	Conc in Soil mg/kg	Invert Uptake Factor	Conc in Invert mg/kg	Sparrow Intake mg/kg	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Invert	Total EQ
Heptachlor	0.0011	10.00	1.07E-02	9.57E-04	92	LD50-quail	100	0.92	1.16	98.84	1.04E-03
Heptachlor epoxide	0.0031	10.00	3.06E-02	2.74E-03	92	LD50-quail	100	0.92	1.16	98.84	2.97E-03
HpCDD Totals	0.0001	5.00	5.32E-04	4.81E-05	0.015	LD50-bobwhite	100	0.00015	2.29	97.71	3.21E-01
Indeno(1,2,3-cd)pyrene	0.0204	a	a	a	a	a	a	a	a	a	a
Lead	59.9168	0.42	2.52E+01	2.85E+00	500	dose-quail	100	5	21.84	78.16	5.70E-01
Methoxychlor	0.0010	113.00	1.08E-01	9.61E-03	2000	LD50-grouse	100	20	0.10	99.90	4.81E-04
Methylene chloride	0.1013	2.30	2.33E-01	2.17E-02	11.59	NOAEL-vole	10	1.159	4.86	95.14	1.87E-02
Naphthalene	3.2046	0.34	1.09E+00	1.30E-01	4000	dose-mallard	10000	0.4	25.66	74.34	3.24E-01
OCDD	0.0007	5.00	3.27E-03	2.96E-04	0.015	LD50-bobwhite	100	0.00015	2.29	97.71	1.97E+00
Phenanthrene	8.0825	0.12	9.70E-01	1.70E-01	4000	dose-mallard	10000	0.4	49.45	50.55	4.25E-01
Pyrene	0.2792	a	a	a	a	a	a	a	a	a	a
Toluene	0.1037	20.00	2.07E+00	1.85E-01	22.9	NOAEL-vole	10	2.29	0.58	99.42	8.06E-02
Vinyl acetate	9.0891	6.09	5.54E+01	4.99E+00	38	LOAEL-rat	100	0.38	1.89	98.11	1.31E+01
Xylene (total)	27.9890	1.90	5.32E+01	5.00E+00	1.82	NOAEL-vole	10	0.182	5.82	94.18	2.75E+01

Savannah sparrow constants:

Food Ingestion Rate (FI):	kg/day	0.005
Soil Ingestion Fraction (S):	unitless	0.104
Water Ingestion Rate (WI):	unitless	0.004
Food Ingestion Fraction (F):	unitless	0.886
Body Weight (BW):	kg	0.021
Home Range:	acres	2.000
Site Area:	acres	1.580
Home Range Fraction (HR):	unitless	0.790
Time on site:	months	6

a = no toxicity data available

EQ sparrow = (HR/BW) x 0.5 [(Conc. in invert x FI x F) + (Conc. in soil x FI x S)]

Conc. in Invert = BAF x Conc. in soil

Table K-9
Fire Protection Training Area
Ecological Quotients for the Kestrel

Chemical	Conc in Soil mg/kg	Sparrow BAF	Conc in Sparrow mg/kg	Kestrel Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Sparrow	Total EQ
1,1,1-Trichloroethane	0.0010	9.00	7.34E-03	9.70E-07	201.4	NOAEL-fox	10	20.14	1.51	98.49	4.82E-08
1,1,2,2-Tetrachloroethane	0.1670	21.00	6.55E+00	8.55E-04	3.2	LOAEL-rat	100	0.032	0.28	99.72	2.67E-02
2-Butanone (MEK)	3.6664	0.98	3.49E-01	9.84E-05	2737	LD50-rat	10000	0.2737	53.86	46.14	3.60E-04
2-Hexanone	2.4221	7.00	1.07E+01	1.42E-03	660	LOAEL-rat	100	6.6	2.46	97.54	2.16E-04
4,4'-DDD	0.0912	5.00	2.07E-01	2.82E-05	0.00041	NOAEL-hawk	1	0.00041	4.68	95.32	6.88E-02
4,4'-DDE	0.0257	5.00	5.82E-02	7.95E-06	0.00041	NOAEL-hawk	1	0.00041	4.68	95.32	1.94E-02
4,4'-DDT	0.4388	5.00	9.94E-01	1.36E-04	0.00041	NOAEL-hawk	1	0.00041	4.68	95.32	3.31E-01
Acenaphthene	0.0204	0.34	2.81E-04	3.32E-07	8	LD50-rat	10000	0.0008	88.98	11.02	4.15E-04
Acenaphthylene	0.1447	a	a	a	a	a	a	a	a	a	a
Aldrin	0.0094	8.00	5.42E-02	7.19E-06	0.086	NOAEL-fox	10	0.0086	1.90	98.10	8.36E-04
alpha-BHC	0.0019	4.20	3.11E-03	4.33E-07	0.289	NOAEL-hawk	1	0.289	6.47	93.53	1.50E-06
Anthracene	1.5766	a	a	a	a	a	a	a	a	a	a
Benz(a)anthracene	0.0152	a	a	a	a	a	a	a	a	a	a
Benzene	0.0114	24.00	5.83E-01	7.60E-05	5.04	NOAEL-fox	10	0.504	0.22	99.78	1.51E-04
Benzo(a)pyrene	0.0173	0.34	2.40E-04	2.81E-07	0.191	NOAEL-fox	10	0.0191	88.88	11.12	1.47E-05
Benzo(b)fluoranthene	0.0202	a	a	a	a	a	a	a	a	a	a
Benzo(g,h,i)perylene	0.0738	a	a	a	a	a	a	a	a	a	a
Benzo(k)fluoranthene	0.0092	a	a	a	a	a	a	a	a	a	a
beta-BHC	0.0023	4.20	3.65E-03	5.08E-07	0.289	NOAEL-hawk	1	0.289	6.47	93.53	1.76E-06
Bromodichloromethane	0.3049	a	a	a	a	a	a	a	a	a	a
Cadmium	0.6028	21.00	2.37E+01	3.09E-03	19.7	NOAEL-rat	10	1.97	0.28	99.72	1.57E-03
Chlorobenzene	0.0460	a	a	a	a	a	a	a	a	a	a
Chrysene	0.0073	0.07	8.52E-06	1.07E-07	0.00027	dose-mallard	100	0.0000027	98.97	1.03	3.97E-02
delta-BHC	0.0053	4.20	8.53E-03	1.19E-06	0.289	NOAEL-hawk	1	0.289	6.47	93.53	4.11E-06
Dibenz(a,h)anthracene	0.0014	a	a	a	a	a	a	a	a	a	a
Dieldrin	0.0017	8.00	9.54E-03	1.27E-06	0.058	NOAEL-hawk	1	0.058	1.90	98.10	2.18E-05
Endosulfan I	0.0070	59.00	2.16E+00	2.82E-04	7.1	NOAEL-hawk	1	7.1	0.04	99.96	3.97E-05
Endosulfan II	0.0052	59.00	1.61E+00	2.09E-04	7.1	NOAEL-hawk	1	7.1	0.04	99.96	2.95E-05
Endrin	0.0041	8.00	2.35E-02	3.11E-06	0.302	NOAEL-hawk	1	0.302	1.90	98.10	1.03E-05
Endrin aldehyde	0.0028	8.00	1.61E-02	2.14E-06	0.302	NOAEL-hawk	1	0.302	1.90	98.10	7.09E-06
Fluoranthene	0.0037	0.08	5.20E-06	5.45E-08	2000	LD50-rat	10000	0.2	98.76	1.24	2.72E-07
Fluorene	0.9656	a	a	a	a	a	a	a	a	a	a
gamma-BHC	0.0013	4.20	2.06E-03	2.86E-07	1.92	NOAEL-hawk	1	1.92	6.47	93.53	1.49E-07
Heptachlor	0.0011	10.00	9.57E-03	1.26E-06	1.5	dose-kestrel	10	0.15	1.23	98.77	8.41E-06

Table K-9
Fire Protection Training Area
Ecological Quotients for the Kestrel

Chemical	Conc in Soil mg/kg	Sparrow BAF	Conc in Sparrow mg/kg	Kestrel Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Sparrow	Total EQ
Heptachlor epoxide	0.0031	10.00	2.74E-02	3.61E-06	1.5	dose-kestrel	10	0.15	1.23	98.77	2.40E-05
HpCDD Totals	0.0001	5.00	2.41E-04	3.29E-08	0.015	LD50-bobwhite	1000	0.000015	4.68	95.32	2.19E-03
Indeno(1,2,3-cd)pyrene	0.0204	a	a	a	a	a	a	a	a	a	a
Lead	59.9168	0.42	1.20E+00	1.02E-03	125	dose-kestrel	10	12.5	84.76	15.24	8.18E-05
Methoxychlor	0.0010	113.00	1.09E+00	1.41E-04	2000	LD50-grouse	1000	2	0.01	99.99	7.07E-05
Methylene chloride	0.1013	2.30	4.99E-02	7.96E-06	2.51	NOAEL-fox	10	0.251	18.42	81.58	3.17E-05
Naphthalene	3.2046	131.00	1.70E+01	2.26E-03	4000	dose-mallard	1000	4	2.05	97.95	5.65E-04
OCDD	0.0007	5.00	1.48E-03	2.02E-07	0.015	LD50-bobwhite	1000	0.000015	4.68	95.32	1.35E-02
Phenanthrene	8.0825	0.12	2.04E-02	1.20E-04	4000	dose-mallard	1000	4	97.78	2.22	2.99E-05
Pyrene	0.2792	a	a	a	a	a	a	a	a	a	a
Toluene	0.1037	20.00	3.69E+00	4.82E-04	4.9	NOAEL-fox	10	0.49	0.31	99.69	9.84E-04
Vinyl acetate	9.0891	6.09	3.04E+01	4.09E-03	38	LOAEL-mouse	100	0.38	3.21	96.79	1.08E-02
Xylene (total)	27.9890	1.90	9.50E+00	1.64E-03	0.394	NOAEL-red fox	10	0.0394	24.67	75.33	4.16E-02

Kestrel Constants:		
Food Ingestion Rate (FI):	kg/day	0.011
Soil Ingestion Fraction (S):	unitless	0.100
Water Ingestion Rate (WI):	L/day	0.014
Food Ingestion Fraction (F):	unitless	0.900
Body Weight (BW):	kg	0.120
Home Range:	acres	499
Site Area:	acres	1.5800
Home Range Fraction (HR):	unitless	0.003166
Time on site:	months	6

a = no toxicity data available

EQ kestrel = kestrel intake/toxicity benchmark

Kestrel intake = (HR/BW) x 0.5 x [(Conc in sparrow x FI x F) + (Conc in Soil x FI x S)]

Conc in Sparrow = BAF x Sparrow intake

Table K-10
POL Tank Farm
Ecological Quotients for Northern Pike from Discharged Groundwater

Chemical	Conc in Water mg/L	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
1,1-Dichloroethene	2.06E-09	11.6	AWQC	1	11.6	1.78E-10
1,2-Dichloroethane	1.10E-05	20	AWQC	1	20	5.52E-07
2,4-Dimethylphenol	4.68E-47	17	LC50-minnow	10000	0.0017	2.75E-44
2-Butanone (MEK)	1.25E-46	5600	LC50-mosquito fish	10000	0.56	2.23E-46
2-Methylnaphthalene	5.70E-03	2	LC50-minnow	10000	0.0002	2.85E+01
2-Methylphenol(o-cresol)	1.30E-46	0.15	AWQC	1	0.15	8.63E-46
4,4'-DDD	9.22E-07	0.000001	AWQC	1	0.000001	9.22E-01
4,4'-DDE	1.13E-06	0.000001	AWQC	1	0.000001	1.13E+00
4,4'-DDT	3.17E-07	0.000001	AWQC	1	0.000001	3.17E-01
4-Methyl-2-Pentanone(MIBK)	1.44E-47	460	LC50-goldfish	10000	0.046	3.13E-46
4-Methylphenol(p-cresol)	5.54E-26	0.15	AWQC	1	0.15	3.70E-25
4-Methylphenol/3-Methylphenol	1.20E-03	0.15	AWQC	1	0.15	7.98E-03
Acetone	7.49E-45	7032	LC50-guppy	10000	0.7032	1.07E-44
Acenaphthylene	1.41E-06	111	EC-carp	10000	0.0111	1.27E-04
Aldrin	5.91E-08	1.9E-06	AWQC	1	0.0000019	3.11E-02
alpha-BHC	2.45E-08	0.032	EC-guppy	10000	0.0000032	7.66E-03
Benzene	4.12E-06	5.3	AWQC	10	0.53	7.78E-06
Benzoic acid	5.08E-02	a	a	a	a	a
Benzyl alcohol	2.21E-05	15	LC50-silverside	10000	0.0015	1.47E-02
beta-BHC	3.12E-08	0.032	EC-guppy	10000	0.0000032	9.74E-03
bis(2-Ethylhexyl)phthalate	1.83E-06	540	LC50-trout	10000	0.054	3.40E-05
Bromochloromethane	3.70E-04	a	a	a	a	a
Chlorobenzene	7.80E-07	16.9	LC50-minnow	10000	0.00169	4.62E-04
Chloroethane	7.75E-17	a	a	a	a	a
Chloromethane	2.30E-09	27	LC50-silverside	10000	0.0027	8.52E-07
Dibenzofuran	1.07E-22	0.0001	dose-pike	100	0.000001	1.07E-16
Dibromomethane	8.30E-10	a	a	a	a	a
Dieldrin	6.74E-08	1.9E-06	AWQC	1	0.0000019	3.55E-02
Endosulfan I	6.66E-75	5.6E-06	AWQC	1	0.0000056	1.19E-69
Endosulfan sulfate	1.30E-07	5.6E-06	AWQC	1	0.0000056	2.32E-02
Endrin	4.27E-09	2.3E-06	AWQC	1	0.0000023	1.86E-03
Endrin aldehyde	6.65E-09	2.3E-06	AWQC	1	0.0000023	2.89E-03
Ethylbenzene	1.24E-05	42.3	LC100-minnow	10000	0.00423	2.94E-03
Fluorene	2.38E-10	0.5	LC50-bluegill	10000	0.00005	4.76E-06
gamma-BHC	3.05E-08	0.023	LC50-salmon	10000	0.0000023	1.33E-02
Heptachlor	2.03E-45	3.8E-06	AWQC	1	0.0000038	5.34E-40
Heptachlor epoxide	1.95E-07	3.8E-06	AWQC	1	0.0000038	5.14E-02
Lead	1.44E-04	0.0032	AWQC	1	0.0032	4.49E-02
Methylene chloride	2.57E-14	193	LC50-minnow	10000	0.0193	1.33E-12
Naphthalene	2.96E-06	0.62	AWQC	1	0.62	4.77E-06
Phenanthrene	1.13E-07	0.0063	AWQC	1	0.0063	1.80E-05
Phenol	1.30E-89	2.56	AWQC	1	2.56	5.08E-90
Thallium	3.79E-04	0.04	AWQC	1	0.04	9.47E-03
Toluene	3.51E-13	17.5	AWQC	10	1.75	2.01E-13
Trichloroethene	9.16E-06	21.9	AWQC	1	21.9	4.18E-07
Trichlorofluoromethane	1.29E-07	a	a	a	a	a
Xylene (total)	2.59E-02	13.5	LC50-trout	100	0.135	1.92E-01

a = No toxicity information available
EQ pike = Concentration in water/toxicty benchmark
Concentration in water = modeled groundwater concentrations, at a 5-feet range from shoreline (see Appendix C)

Table K-11
POL Tank Farm
Ecological Quotients for Aquatic Invertebrates at the Mudflats

Chemical	Conc in GW mg/L	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
1,1-Dichloroethene	2.766E-07	11.6	AWQC	1	11.6	2.38E-08
1,2-Dichloroethane	0.0007632	20	AWQC	1	20	3.82E-05
2,4-Dimethylphenol	6.28E-45	2.12	LC50-daphnia	100	0.0212	2.96E-43
2-Butanone (MEK)	1.675E-44	3220	LC50-fish	10000	0.322	5.20E-44
2-Methylnaphthalene	0.7642724	1.1	LC50-shrimp	10000	0.00011	6.95E+03
2-Methylphenol(o-cresol)	1.737E-44	0.15	AWQC	1	0.15	1.16E-43
4,4'-DDD	0.0001237	0.000001	AWQC	1	0.000001	1.24E+02
4,4'-DDE	0.0001518	0.000001	AWQC	1	0.000001	1.52E+02
4,4'-DDT	2.845E-05	0.000001	AWQC	1	0.000001	2.85E+01
4-Methyl-2-Pentanone(MIBK)	1.934E-45	505	LC50-fish	10000	0.0505	3.83E-44
4-Methylphenol(p-cresol)	7.439E-24	0.15	AWQC	1	0.15	4.96E-23
4-Methylphenol/3-Methylphenol	0.1604972	0.15	AWQC	1	0.15	1.07E+00
Acetone	1.005E-42	6190	LC50-mosquito	100	61.9	1.62E-44
Acenaphthylene	0.0001893	111	EC-carp	10000	0.0111	1.71E-02
Aldrin	7.93E-06	0.0000019	AWQC	1	0.0000019	4.17E+00
alpha-BHC	5.697E-07	0.1	EC50-daphnia	100	0.001	5.70E-04
Benzene	4.477E-08	5.3	AWQC	1	5.3	8.45E-09
Benzoic acid	6.8147626	a	a	a	a	a
Benzyl alcohol	0.0029616	15	LC50-fish	10000	0.0015	1.97E+00
beta-BHC	5.219E-09	0.1	EC50-daphnia	100	0.001	5.22E-06
bis(2-Ethylhexyl)phthalate	0.0002461	540	LC50-trout	1000	0.54	4.56E-04
Bromochloromethane	0.0132474	a	a	a	a	a
Chlorobenzene	0.0001047	1.8	LC50-fish	10000	0.00018	5.82E-01
Chloroethane	1.04E-14	a	a	a	a	a
Chloromethane	1.925E-12	27	LC50-fish	10000	0.0027	7.13E-10
Dibenzofuran	1.434E-20	1E-08	AWQC	1	0.00000001	1.43E-12
Dibromomethane	1.907E-15	a	a	a	a	a
Dieldrin	5.626E-06	0.0000019	AWQC	1	0.0000019	2.96E+00
Endosulfan I	8.933E-73	0.0000056	AWQC	1	0.0000056	1.60E-67
Endosulfan sulfate	1.745E-05	0.0000056	AWQC	1	0.0000056	3.12E+00
Endrin	5.732E-07	0.0000023	AWQC	1	0.0000023	2.49E-01
Endrin aldehyde	8.917E-07	0.0000023	AWQC	1	0.0000023	3.88E-01
Ethylbenzene	0.0016435	275	LC50-shrimp	10000	0.0275	5.98E-02
Fluorene	3.195E-08	1	LC50-shrimp	10000	0.0001	3.19E-04
gamma-BHC	2.893E-07	0.46	LC48-daphnia	100	0.0046	6.29E-05
Heptachlor	8.79E-118	0.0000038	AWQC	1	0.0000038	2.31E-112
Heptachlor epoxide	2.22E-05	0.0000038	AWQC	1	0.0000038	5.84E+00
Lead	0.0104451	0.0032	AWQC	1	0.0032	3.26E+00
Methylene chloride	3.451E-12	224	LC50-daphnia	100	2.24	1.54E-12
Naphthalene	0.0003971	0.62	AWQC	1	0.62	6.41E-04
Phenanthrene	1.52E-05	0.063	AWQC	1	0.063	2.41E-04
Phenol	1.743E-87	2.56	AWQC	1	2.56	6.81E-88
Thallium	0.0508241	0.004	AWQC	1	0.004	1.27E+01
Toluene	2.693E-21	17.5	AWQC	1	17.5	1.54E-22
Trichloroethene	0.0012288	21.9	AWQC	1	21.9	5.61E-05
Trichlorofluoromethane	1.728E-05	a	a	a	a	a
Xylene (total)	3.4807293	13	LC50-fish	10000	0.0013	2.68E+03

a = No toxicity data available
EQ=Concentration in water/toxicity benchmark

Table K-11
POL Tank Farm
Ecological Quotients for Aquatic Invertebrates at the Mudflats

Chemical	Conc in GW mg/L	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
Concentration in water = modeled groundwater concentrations discharging to the shoreline (see Appendix C)						

Table K-12
POL Tank Farm
Ecological Quotients for the Spotted Sandpiper

Chemical	Conc in Water mg/L	Insect Uptake Factor	Conc in Invert mg/kg	SSP Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Water	% EQ Invert.	Total EQ
1,1-Dichloroethene	2.766E-07	2.5	6.92E-07	1.69E-06	59.5	NOAEL-vole	10	5.95	97.77	2.23	2.85E-07
1,2-Dichloroethane	0.0007632	2	0.001526	4.65E-03	46.81	NOAEL-robin	1	46.81	98.21	1.79	9.94E-05
2,4-Dimethylphenol	6.28E-45	0.07	4.4E-46	3.76E-44	17	LC50-fish	10000	0.0017	99.94	0.06	2.21E-41
2-Butanone (MEK)	1.675E-44	0.98	1.64E-44	1.01E-43	1080	LOAEL-rat	100	10.8	99.12	0.88	9.37E-45
2-Methylnaphthalene	0.7642724	1000	764.2724	4.62E+01	1630	LD50-rat	10000	0.163	9.90	90.10	2.84E+02
2-Methylphenol(o-cresol)	1.737E-44	18	3.13E-43	1.21E-43	606	NOAEL-vole	10	60.6	85.92	14.08	2.00E-45
4,4'-DDD	0.0001237	12000	1.484556	8.17E-02	0.00032	NOAEL-heron	10	0.000032	0.91	99.09	2.55E+03
4,4'-DDE	0.0001518	12000	1.821955	1.00E-01	0.00032	NOAEL-heron	10	0.000032	0.91	99.09	3.13E+03
4,4'-DDT	2.845E-05	12000	0.341448	1.88E-02	0.00032	NOAEL-heron	10	0.000032	0.91	99.09	5.87E+02
4-Methyl-2-Pentanone(MIBK)	1.934E-45	2.1	4.06E-45	1.18E-44	100	LD50-blackbird	10000	0.01	98.12	1.88	1.18E-42
4-Methylphenol(p-cresol)	7.439E-24	18	1.34E-22	5.18E-23	606	NOAEL-vole	10	60.6	85.92	14.08	8.55E-25
4-Methylphenol/3-Methylphenol	0.1604972	18	2.88895	1.12E+00	606	NOAEL-vole	10	60.6	85.92	14.08	1.85E-02
Acetone	1.005E-42	0.69	6.93E-43	6.05E-42	40000	LD50-pheasant	10000	4	99.38	0.62	1.51E-42
Acenaphthylene	0.0001893	2.6	0.000492	1.16E-03	1700	LD50-rat	10000	0.17	97.69	2.31	6.83E-03
Aldrin	7.93E-06	3140	0.024901	1.41E-03	0.045	NOAEL-heron	10	0.0045	3.38	96.62	3.12E-01
alpha-BHC	5.697E-07	1100	0.000627	3.76E-05	0.226	NOAEL-heron	10	0.0226	9.08	90.92	1.66E-03
Benzene	4.477E-08	4.27	1.91E-07	2.78E-07	23.23	NOAEL-vole	10	2.323	96.26	3.74	1.20E-07
Benzoic acid	6.8147626	21	143.11	4.86E+01	1940	LD50-mouse	10000	0.194	83.95	16.05	2.51E+02
Benzyl alcohol	0.0029616	4	0.011846	1.84E-02	1230	LD50-rat	10000	0.123	96.49	3.51	1.49E-01
beta-BHC	5.219E-09	1460	7.62E-06	4.47E-07	0.226	NOAEL-heron	10	0.0226	7.00	93.00	1.98E-05
bis(2-Ethylhexyl)phthalate	0.0002461	57	0.014028	2.24E-03	1.39	NOAEL-robin	10	0.139	65.83	34.17	1.61E-02
Bromochloromethane	0.0132474	a	a	a	a	a	a	a	a	a	a
Chlorobenzene	0.0001047	70	0.007329	1.03E-03	1000	LOAEL-rat	10000	0.1	61.07	38.93	1.03E-02
Chloroethane	1.04E-14	a	a	a	a	a	a	a	a	a	a
Chloromethane	1.925E-12	2.88	5.54E-12	1.18E-11	500	LOAEL-mouse	100	5	97.44	2.56	2.37E-12
Dibenzofuran	1.434E-20	589	8.45E-18	5.46E-19	0.015	LD50-bobwhite	10000	0.0000015	15.72	84.28	3.64E-13
Dibromomethane	1.907E-15	a	a	a	a	a	a	a	a	a	a
Dieldrin	5.626E-06	2700	0.01519	8.62E-04	0.045	NOAEL-heron	10	0.0045	3.91	96.09	1.92E-01
Endosulfan I	8.933E-73	59	5.27E-71	8.22E-72	17.22	NOAEL-robin	10	1.722	65.05	34.95	4.77E-72
Endosulfan sulfate	1.745E-05	59	0.00103	1.61E-04	17.22	NOAEL-robin	10	1.722	65.05	34.95	9.33E-05
Endrin	5.732E-07	121	6.94E-05	7.21E-06	0.73	NOAEL-robin	10	0.073	47.58	52.42	9.88E-05
Endrin aldehyde	8.917E-07	121	0.000108	1.12E-05	0.73	NOAEL-robin	10	0.073	47.58	52.42	1.54E-04
Ethylbenzene	0.0016435	144	0.23667	2.27E-02	3500	LD50-rat	10000	0.35	43.27	56.73	6.50E-02

Table K-12
POL Tank Farm
Ecological Quotients for the Spotted Sandpiper

Chemical	Conc in Water mg/L	Insect Uptake Factor	Conc in Invert mg/kg	SSP Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Water	% EQ Invert.	Total EQ
Fluorene	3.195E-08	5000	0.00016	8.90E-06	2000	LD50-rat	10000	0.2	2.15	97.85	4.45E-05
gamma-BHC	2.893E-07	319	9.23E-05	6.76E-06	4.66	NOAEL-robin	10	0.466	25.61	74.39	1.45E-05
Heptachlor	8.79E-118	20	1.8E-116	6.22E-117	92	LC50-quail	10000	0.0092	84.59	15.41	6.76E-115
Heptachlor epoxide	2.22E-05	20	0.000444	1.57E-04	92	LC50-quail	10000	0.0092	84.59	15.41	1.71E-02
Lead	0.0104451	42	0.438692	8.65E-02	100	dose-gull	10000	0.01	72.34	27.66	8.65E+00
Methylene chloride	3.451E-12	2.3	7.94E-12	2.11E-11	8.49	LD50-chicken	10000	0.000849	97.95	2.05	2.48E-08
Naphthalene	0.0003971	1000	0.397125	2.40E-02	4000	dose-mallard	10000	0.4	9.90	90.10	6.01E-02
Phenanthrene	1.52E-05	325	0.004939	3.60E-04	700	LD50-mouse	10000	0.07	25.26	74.74	5.15E-03
Phenol	1.743E-87	20	3.49E-86	1.23E-86	980	Dose-rat	10000	0.098	84.59	15.41	1.26E-85
Thallium	0.0508241	34	1.72802	3.99E-01	0.7	LOAEL-rat	100	0.007	76.36	23.64	5.69E+01
Toluene	2.693E-21	90	2.42E-19	2.93E-20	22.9	NOAEL-vole	10	2.29	54.96	45.04	1.28E-20
Trichloroethene	0.0012288	17	0.02089	8.50E-03	1000	LOAEL-mouse	100	10	86.60	13.40	8.50E-04
Trichlorofluoromethane	1.728E-05	a	a	a	a	a	a	a	a	a	a
Xylene (total)	3.4807293	80	278.4583	3.60E+01	1.82	NOAEL-vole	10	0.182	57.86	42.14	1.98E+02

Spotted Sandpiper constants:

Body weight:	kg	0.047
Water Intake:	Liters/day	0.67
Food Ingestion rate:	kg/day	0.00744
Soil Ingestion fraction (S):	unitless	0.18
Food Ingestion fraction (F):	unitless	0.82
Home Range:	acres	2.5
Time on site:	months	5
Home Range Fraction (HR):	unitless	1
Site area	acres	6.39

EQ = sandpiper intake/toxicity benchmark
Intake = (HR/BW) x 0.42 x ((Conc in Invert x FI x FF) + (Conc in water x WI))
Conc. in Water = modeled groundwater concentrations discharged to the mudflats (see Appendix C)

Table K-13
Waste Accumulation Area
Ecological Quotients for the Northern Pike from Discharged Groundwater

Chemical	Conc in Water mg/L	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
1,2-Dichloroethane	1.12E-05	20	AWQC	1	20	5.61E-07
4,4'-DDT	3.93E-07	0.000001	AWQC	1	0.000001	3.93E-01
alpha-BHC	2.61E-08	0.032	EC-guppy	10000	0.0000032	8.15E-03
Arsenic	9.51E-05	0.19	AWQC	1	0.19	5.01E-04
Barium	2.77E-03	68	LC50-daphnia	10000	0.0068	4.08E-01
Benzene	9.78E-06	5.3	AWQC	10	0.53	1.84E-05
Benzoic acid	5.08E-02	a	a	a	a	a
beta-BHC	3.67E-08	0.032	EC-guppy	10000	0.0000032	1.15E-02
bis(2-Ethylhexyl)phthalate	2.21E-06	540	LC50-trout	10000	0.054	4.10E-05
Bromochloromethane	4.61E-03	a	a	a	a	a
Chloromethane	2.30E-09	27	LC50-silverside	10000	0.0027	8.52E-07
cis-1,2-Dichloroethene	5.13E-03	11.6	AWQC	1	11.6	4.42E-04
Cobalt	7.63E-05	100	EC-minnow	10000	0.01	7.63E-03
delta-BHC	2.24E-10	0.032	EC-guppy	10000	0.0000032	7.01E-05
Dibromomethane	8.30E-10	a	a	a	a	a
Dieldrin	1.19E-07	0.0000019	AWQC	1	0.0000019	6.27E-02
Endosulfan sulfate	1.33E-07	0.0000056	AWQC	1	0.0000056	2.38E-02
Endrin aldehyde	9.96E-08	0.0000023	AWQC	1	0.0000023	4.33E-02
gamma-BHC	3.29E-08	0.023	LC50-salmon	10000	0.0000023	1.43E-02
Heptachlor	2.03E-45	0.0000038	AWQC	1	0.0000038	5.34E-40
Lead	2.05E-04	0.0032	AWQC	1	0.0032	6.42E-02
Manganese	7.15E-02	130	LC50-dace	3000	0.043333333	1.65E+00
Methoxychlor	2.08E-07	0.0003	AWQC	1	0.0003	6.93E-04
Nickel	1.00E-04	0.0083	AWQC	1	0.0083	1.21E-02
Selenium	2.94E-05	0.005	AWQC	1	0.005	5.89E-03
Vinyl Chloride	1.02E-06	388	EC50-pike	100	3.88	2.64E-07
Zinc	1.15E-04	0.11	AWQC	1	0.11	1.05E-03

a = no toxicity information available

EQ pike =concentration in water/toxicity benchmark
Concentration in water = modeled groundwater concentrations at a 5-feet range from shoreline (see Appendix C)

Table K-14
Waste Accumulation Area
Ecological Quotients for Aquatic Invertbrates at the Mudflats

Chemical	Conc in GW mg/L	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
1,2-Dichloroethane	5.52E-05	20	AWQC	1	20	2.76E-06
4,4'-DDT	2.42E-05	0.000001	AWQC	1	0.000001	2.42E+01
alpha-BHC	2.7E-07	0.1	EC50-daphnia	100	0.001	2.70E-04
Arsenic	0.006399	0.036	AWQC	1	0.036	1.78E-01
Barium	0.563097	68	LC50-daphnia	100	0.68	8.28E-01
Benzene	1.81E-11	5.3	AWQC	1	5.3	3.42E-12
Benzoic acid	0.005119	a	a	a	a	a
beta-BHC	4.72E-07	0.1	EC50-daphnia	100	0.001	4.72E-04
bis(2-Ethylhexyl)phthalate	9.14E-05	540	LC50-trout	1000	0.54	1.69E-04
Bromochloromethane	0.02342	a	a	a	a	a
Chloromethane	5.2E-13	27	LC50-fish	10000	0.0027	1.93E-10
cis-1,2-Dichloroethene	0.001446	11.6	AWQC-acute	10	1.16	1.25E-03
Cobalt	0.040953	100	EC50-fish	10000	0.01	4.10E+00
delta-BHC	1.2E-07	0.1	EC50-daphnia	100	0.001	1.20E-04
Dibromomethane	1.68E-13	a	a	a	a	a
Dieldrin	6.72E-06	0.0000019	AWQC	1	0.0000019	3.54E+00
Endosulfan sulfate	2.56E-07	0.0000056	AWQC	1	0.0000056	4.57E-02
Endrin aldehyde	1.41E-06	0.0000023	AWQC	1	0.0000023	6.12E-01
gamma-BHC	4.43E-07	0.46	LC48-daphnia	100	0.0046	9.62E-05
Heptachlor	1.4E-101	0.0000038	AWQC	1	0.0000038	3.70E-96
Lead	0.023036	0.0032	AWQC	1	0.0032	7.20E+00
Manganese	38.39301	130	LC50-fish	10000	0.013	2.95E+03
Methoxychlor	1.76E-06	0.0003	AWQC	1	0.0003	5.88E-03
Nickel	0.05375	0.0083	AWQC	1	0.0083	6.48E+00
Selenium	0.008958	0.005	AWQC	1	0.005	1.79E+00
Vinyl Chloride	1.69E-05	388	EC50-pike	10000	0.0388	4.36E-04
Zinc	0.061813	0.11	AWQC	1	0.11	5.62E-01

a = no toxicity data available
EQ = Concentration in water/toxicity benchmark
Concentration in water = modeled groundwater concentrations discharging to the shoreline (see Appendix C)

Table K-15
Waste Accumulation Area
Ecological Quotients for the Spotted Sandpiper at the Mudflats

Chemical	Conc in GW mg/L	Insect Uptake Factor	Conc in Invert mg/kg	SSP Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Water	% EQ Invert.	Total EQ
1,2-Dichloroethane	5.52E-05	2	0.00011	1.13E-04	46.81	NOAEL-robin	1	46.81	98.21	1.79	2.42E-06
4,4'-DDT	2.42E-05	12000	0.290181	5.36E-03	0.00032	NOAEL-heron	10	0.000032	0.91	99.09	1.68E+02
alpha-BHC	2.7E-07	1100	0.000297	5.99E-06	0.226	NOAEL-heron	10	0.0226	9.08	90.92	2.65E-04
Arsenic	0.006399	9	0.05759	1.39E-02	0.111	NOAEL-vole	10	0.0111	92.43	7.57	1.25E+00
Barium	0.563097	120	67.5717	2.37E+00	10.77	NOAEL-vole	10	1.077	47.79	52.21	2.20E+00
Benzene	1.81E-11	4.27	7.74E-11	3.79E-11	23.23	NOAEL-vole	10	2.323	96.26	3.74	1.63E-11
Benzoic acid	0.005119	21	0.1075	1.23E-02	1940	LD50-mouse	10000	0.194	83.95	16.05	6.32E-02
beta-BHC	4.72E-07	1460	0.000689	1.36E-05	0.226	NOAEL-heron	10	0.0226	7.00	93.00	6.00E-04
bis(2-Ethylhexyl)phthalate	9.14E-05	57	0.005211	2.79E-04	1.39	NOAEL-robin	10	0.139	65.83	34.17	2.01E-03
Bromochloromethane	0.02342	a	a	a	a	a	a	a	a	a	a
Chloromethane	5.2E-13	2.88	1.5E-12	1.07E-12	500	LOAEL-mouse	100	5	97.44	2.56	2.15E-13
cis-1,2-Dichloroethene	0.001446	23	0.033261	3.52E-03	39.8	NOAEL-vole	10	3.98	82.68	17.32	8.84E-04
Cobalt	0.040953	40	1.638102	1.12E-01	5.7	LD50-rat	10000	0.00057	73.30	26.70	1.97E+02
delta-BHC	1.2E-07	850	0.000102	2.12E-06	0.226	NOAEL-heron	10	0.0226	11.44	88.56	9.37E-05
Dibromomethane	1.68E-13	a	a	a	a	a	a	a	a	a	a
Dieldrin	6.72E-06	2700	0.018136	3.46E-04	0.045	NOAEL-heron	10	0.0045	3.91	96.09	7.68E-02
Endosulfan sulfate	2.56E-07	59	1.51E-05	7.92E-07	17.22	NOAEL-robin	10	1.722	65.05	34.95	4.60E-07
Endrin aldehyde	1.41E-06	121	0.00017	5.95E-06	0.73	NOAEL-robin	10	0.073	47.58	52.42	8.15E-05
gamma-BHC	4.43E-07	319	0.000141	3.48E-06	4.66	NOAEL-robin	10	0.466	25.61	74.39	7.46E-06
Heptachlor	1.4E-101	20	2.8E-100	3.34E-101	92	LC50-quail	10000	0.0092	84.59	15.41	3.63E-99
Lead	0.023036	42	0.967504	6.41E-02	100	dose-gull	10000	0.01	72.34	27.66	6.41E+00
Manganese	38.39301	22.6	867.682	9.31E+01	174.45	NOAEL-vole	10	17.445	82.93	17.07	5.34E+00
Methoxychlor	1.76E-06	113	0.000199	7.20E-06	2000	LD50-mallard	10000	0.2	49.29	50.71	3.60E-05
Nickel	0.05375	100	5.375021	2.07E-01	50	LOAEL-mouse	100	0.5	52.34	47.66	4.13E-01
Selenium	0.008958	10.5	0.094063	1.97E-02	0.066	Dose-mallard	10	0.0066	91.27	8.73	2.99E+00
Vinyl Chloride	1.69E-05	5.1	8.64E-05	3.56E-05	5.6	LOAEL-rat	100	0.056	95.56	4.44	6.37E-04
Zinc	0.061813	8	0.494502	1.33E-01	317.19	NOAEL-vole	10	31.719	93.21	6.79	4.21E-03

Spotted Sandpiper constants:

Body weight (BW):	kg	0.047	a = no toxicity data available
Water Intake (WI):	L/day	0.67	EQ = sandpiper intake/toxicity benchmark
Food Ingestion rate (FI):	kg/day	0.00744	Intake = (HR/BW) x 0.42 x ((Conc in Invert x FI x FF) + (Conc in water x WI))
Soil Ingestion fraction (S):	unitless	0.18	Conc. in Water = modeled groundwater concentrations discharged to the mudflats (Appendix C)

Table K-15
Waste Accumulation Area
Ecological Quotients for the Spotted Sandpiper at the Mudflats

Chemical	Conc in GW mg/L	Insect Uptake Factor	Conc in Invert mg/kg	SSP Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Water	% EQ Invert.	Total EQ
Food Ingestion fraction (F):	unitless	0.82									
Home Range:	acres	2.5									
Time on site:	months	5									
Home Range Fraction (HR):	unitless	0.336									
Site Area:	acres	0.84									

Table K-16
Waste Accumulation Area
Ecological Quotients for Terrestrial Plants

Chemical	Conc in Soil mg/kg	Tox Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Ecological Quotients
2-Methylnaphthalene	0.0162557	a	a	a	a	a
4,4'-DDD	4.609099	a	a	a	a	a
4,4'-DDE	0.3491177	a	a	a	a	a
4,4'-DDT	6.1674321	a	a	a	a	a
Acenaphthene	0.0434313	a	a	a	a	a
Aldrin	0.0088931	a	a	a	a	a
Anthracene	0.50239	a	a	a	a	a
Benz(a)anthracene	0.4683893	a	a	a	a	a
Benzo(a)pyrene	0.3745214	a	a	a	a	a
Benzo(b)fluoranthene	0.4000089	a	a	a	a	a
Benzo(g,h,i)perylene	0.1937719	a	a	a	a	a
Benzo(k)fluoranthene	0.4031546	a	a	a	a	a
Benzoic acid	0.0684733	a	a	a	a	a
bis(2-Ethylhexyl)phthalate	0.8613209	a	a	a	a	a
Cadmium	0.4912263	a	a	a	a	a
Chrysene	0.5656873	a	a	a	a	a
Dibenz(a,h)anthracene	0.1247134	a	a	a	a	a
Dieldrin	0.2146482	a	a	a	a	a
Endosulfan I	0.0048722	a	a	a	a	a
Endosulfan II	0.0010777	a	a	a	a	a
Endosulfan sulfate	0.0020481	a	a	a	a	a
Endrin	0.0241381	a	a	a	a	a
Endrin aldehyde	0.0011918	a	a	a	a	a
Fluoranthene	1.3159604	a	a	a	a	a
Fluorene	0.0355753	a	a	a	a	a
gamma-BHC	0.0083141	a	a	a	a	a
Heptachlor	0.0002578	a	a	a	a	a
Heptachlor epoxide	0.0014101	a	a	a	a	a
Indeno(1,2,3-cd)pyrene	0.1754652	a	a	a	a	a
Lead	184.1576373	50	LOEC	1	50	3.68E+00
Methoxychlor	0.0017364	a	a	a	a	a
Naphthalene	0.0080908	a	a	a	a	a
Phenanthrene	0.6525414	a	a	a	a	a
Pyrene	0.8139525	a	a	a	a	a

a = No toxicity data available
EQ plant = Concentration in soil/toxicity benchmark

Table K-17
Waste Accumulation Area
Ecological Quotients for the Meadow Vole

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	log Kow	Plant Uptake Factor	Conc in Plants mg/kg	MV Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Plant	Total EQ
1,2-Dichloroethane	0.0000	0.00042	1.45	5.622119	0	5.71E-05	46.3	NOAEL-vole	1	46.3	0	100.00	0.00	1.23E-06
2-Methylnaphthalene	0.0163	0.07	3.86	0.227468	0.003698	0.010015	1630	LD50-rat	6000	0.27166667	0.489425	94.98	4.53	3.69E-02
2-Methylphenol(o-cresol)	0.0000	0.022	1.95	2.890014	0	0.00299	606	NOAEL-vole	1	606	0	100.00	0.00	4.93E-06
4,4'-DDD	4.6091	0.00025	6.2	0.010102	0.04656	0.019642	1.58	NOAEL-vole	1	1.58	70.75878	0.17	29.07	1.24E-02
4,4'-DDE	0.3491	0.000023	7	0.003483	0.001216	0.001205	1.58	NOAEL-vole	1	1.58	87.36476	0.26	12.38	7.63E-04
4,4'-DDT	6.1674	0	6.19	0.010237	0.063137	0.026339	1.58	NOAEL-vole	1	1.58	70.60593	0.00	29.39	1.67E-02
4-Methylphenol(p-cresol)	0.0000	0.09	1.94	2.928734	0	0.012231	450	LOAEL-rat	60	7.5	0	100.00	0.00	1.63E-03
Acenaphthene	0.0434	0	3.92	0.21001	0.009121	0.001249	2	dose-rat	6000	0.00033333	10.48173	0.00	89.52	3.75E+00
Aldrin	0.0089	0	5.68	0.020182	0.000179	4.88E-05	0.396	NOAEL-vole	1	0.396	54.92312	0.00	45.08	1.23E-04
Anthracene	0.5024	0	4.45	0.103729	0.052112	0.007905	430	LD50-rodent	6000	0.07166667	19.16329	0.00	80.84	1.10E-01
Antimony	0.0000	0.11	b	0.2	0	0.014949	300	LOAEL-rat	60	5	0	100.00	0.00	2.99E-03
Arsenic	0.0000	0.016	b	0.04	0	0.002174	0.111	NOAEL-vole	1	0.111	0	100.00	0.00	1.96E-02
Barium	0.0000	0.4	b	0.15	0	0.054359	10.77	NOAEL-vole	1	10.77	0	100.00	0.00	5.05E-03
Benz(a)anthracene	0.4684	0	5.6	0.022449	0.010515	0.002702	2	dose-rodent	6000	0.00033333	52.27577	0.00	47.72	8.11E+00
Benzene	0.0000	0.076	2.13	2.274364	0	0.010328	23.23	NOAEL-vole	1	23.23	0	100.00	0.00	4.45E-04
Benzo(a)pyrene	0.3745	0	6.19	0.010237	0.003834	0.001599	10	LD50-rodent	6000	0.00166667	70.60593	0.00	29.39	9.60E-01
Benzo(b)fluoranthene	0.4000	0	6.06	0.012171	0.004868	0.001803	40	dose-rodent	6000	0.00666667	66.89201	0.00	33.11	2.70E-01
Benzo(g,h,i)perylene	0.1938	0	6.5	0.006776	0.001313	0.000745	0.8	dose-mouse	6000	0.00013333	78.39607	0.00	21.60	5.59E+00
Benzo(k)fluoranthene	0.4032	0	6.06	0.012171	0.004907	0.001817	72	dose-mouse	6000	0.012	66.89201	0.00	33.11	1.51E-01
Benzoic acid	0.0685	0.068	1.87	3.214697	0.220121	0.03644	1940	LD50-mouse	6000	0.32333333	0.566612	25.36	74.07	1.13E-01
Benzyl alcohol	0.0000	0.0075	1.1	8.957772	0	0.001019	1580	LD50-mouse	6000	0.26333333	0	100.00	0.00	3.87E-03
beta-BHC	0.0000	0.00003	4.5	0.097051	0	4.08E-06	3.17	NOAEL-vole	1	3.17	0	100.00	0.00	1.29E-06
bis(2-Ethylhexyl)phthalate	0.8613	0	4.88	0.058528	0.050411	0.008779	16.15	NOAEL-vole	1	16.15	29.58476	0.00	70.42	5.44E-04
Cadmium	0.4912	0	b	0.121	0.059438	0.00877	19.7	NOAEL-rat	6	3.28333333	16.88999	0.00	83.11	2.67E-03
Chrysene	0.5657	0	5.6	0.022449	0.012699	0.003263	99	dose-rodent	6000	0.0165	52.27577	0.00	47.72	1.98E-01
Cobalt	0.0000	0.016	b	0.02	0	0.002174	13.25	LOAEL-rat	60	0.22083333	0	100.00	0.00	9.85E-03
delta-BHC	0.0000	0.000031	2.8	0.932395	0	4.21E-06	3.17	NOAEL-vole	1	3.17	0	100.00	0.00	1.33E-06
Dibenz(a,h)anthracene	0.1247	0	6.83	0.004368	0.000545	0.000443	5	dose-rat	6000	0.00083333	84.91684	0.00	15.08	5.31E-01
Dieldrin	0.2146	0	4.32	0.123322	0.026471	0.003893	0.04	NOAEL-vole	1	0.04	16.62	0.00	83.38	9.73E-02
Endosulfan I	0.0049	0	3.83	0.236734	0.001153	0.000156	0.29	NOAEL-vole	1	0.29	9.41	0.00	90.59	5.38E-04
Endosulfan II	0.0011	0	3.52	0.357635	0.000385	5.05E-05	0.29	NOAEL-vole	1	0.29	6.43	0.00	93.57	1.74E-04
Endosulfan sulfate	0.0020	0	3.66	0.296838	0.000608	8.07E-05	0.29	NOAEL-vole	1	0.29	7.65	0.00	92.35	2.78E-04
Endrin	0.0241	0	5.33	0.032156	0.000776	0.000168	0.081	NOAEL-vole	1	0.081	43.33	0.00	56.67	2.07E-03
Endrin aldehyde	0.0012	0	3.14	0.593035	0.000707	9.03E-05	0.081	NOAEL-vole	1	0.081	3.98	0.00	96.02	1.11E-03
Ethylbenzene	0.0000	0.003	3.15	0.585194	0	0.000408	408	dose-rat	6000	0.068	0.00	100.00	0.00	6.00E-03
Fluoranthene	1.3160	0.00018	4.89	0.057754	0.076002	0.013312	2000	dose-rat	6000	0.33333333	29.81	0.18	70.01	3.99E-02
Fluorene	0.0356	0.0034	4.17	0.150571	0.005357	0.001226	8.6	dose-rat	6000	0.00143333	8.75	37.68	53.57	8.55E-01
gamma-BHC	0.0083	0	3.3	0.479292	0.003985	0.000514	15.8	NOAEL-vole	1	15.8	4.88	0.00	95.12	3.25E-05
Heptachlor	0.0003	0	5.44	0.027777	7.16E-06	1.66E-06	1.58	NOAEL-vole	1	1.58	46.96	0.00	53.04	1.05E-06
Heptachlor epoxide	0.0014	0.00043	5.4	0.029295	4.13E-05	6.78E-05	1.58	NOAEL-vole	1	1.58	6.28	86.25	7.48	4.29E-05
Indeno(1,2,3-cd)pyrene	0.1755	0	6.5	0.006776	0.001189	0.000675	72	dose-rodent	6000	0.012	78.40	0.00	21.60	5.62E-02
Lead	184.1576	0	b	0.045	8.287094	1.571516	15.86	NOAEL-vole	1	15.86	35.34	0.00	64.66	9.91E-02

Table K-17
Waste Accumulation Area
Ecological Quotients for the Meadow Vole

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	log Kow	Plant Uptake Factor	Conc in Plants mg/kg	MV Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Plant	Total EQ
Manganese	0.0000	6	b	0.25	0	0.815385	174.45	NOAEL-vole	1	174.45	0.00	100.00	0.00	4.67E-03
Methoxychlor	0.0017	0	5.08	0.04485	7.79E-05	1.48E-05	60	LOAEL-rat	60	1	35.41	0.00	64.59	1.48E-05
Naphthalene	0.0081	0.049	3.29	0.485713	0.00393	0.007165	1780	LD50-rodent	6000	0.29666667	0.34	92.93	6.73	2.42E-02
Phenanthrene	0.6525	0.0013	4.38	0.113857	0.074296	0.011255	700	dose-mouse	6000	0.11666667	17.48	1.57	80.95	9.65E-02
Pyrene	0.8140	0.00021	4.9	0.05699	0.046387	0.008171	800	LD50-mouse	6000	0.13333333	5.29	0.06	15.07	6.13E-02
Toluene	0.0000	0.06	2.69	1.079394	0	0.008154	22.9	NOAEL-vole	1	22.9	0.00	100.00	0.00	3.56E-04
Xylene (total)	0.0000	0.057	4.9	0.05699	0	0.007746	1.82	NOAEL-vole	1	1.82	0.00	100.00	0.00	4.26E-03
Zinc	0.0000	0.02	b	1.5	0	0.002718	317.19	NOAEL-vole	1	317.19	0.00	100.00	0.00	8.57E-06

Meadow Vole constants:		
Food Ingestion Rate (FI):	kg/day	0.0049
Soil Ingestion Fraction (S):	unitless	0.024
Water Ingestion Rate (WI):	L/day	0.0053
Food Ingestion Fraction (F):	unitless	0.976
Body Weight (BW):	kg	0.039
Home Range:	acres	0.34
Site Area:	acres	0.81
Home Range Fraction (HR):	unitless	1

a = no toxicity data available
b = Kow not applicable to metals

EQvole = vole intake/toxicity benchmark
Vole intake = (HR/BW) x [(Conc in plants x FI x F) + (Conc in soil x FI x S) + (Conc in water x WI)]
Conc in plants = Conc in soil x plant uptake factor

Table K-18
Waste Accumulation Area
Ecological Quotients for the Red Fox

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	MV BAF	Conc in MVs mg/kg	Red Fox Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ MV	Total EQ
1,2-Dichloroethane	0	0.00042	2	0.00011	1.87E-08	10.06	NOAEL-red fox	1	10.06	0.00	86.14	13.86	1.86E-09
2-Methylnaphthalene	0.01626	0.07	0.342	0.00343	2.77E-06	1630	LD50-rat	10000	0.163	0.38	96.81	2.80	1.70E-05
2-Methylphenol(o-cresol)	0	0.022	17.78	0.05316	2.05E-06	131.6	NOAEL-red fox	1	131.6	0.00	41.14	58.86	1.56E-08
4,4'-DDD	4.6091	0.00025	5	0.09821	5.25E-06	0.34	NOAEL-red fox	1	0.34	57.38	0.18	42.44	1.54E-05
4,4'-DDE	0.34912	0.000023	5	0.00602	3.66E-07	0.34	NOAEL-red fox	1	0.34	62.39	0.24	37.37	1.08E-06
4,4'-DDT	6.16743	0	5	0.1317	7.02E-06	0.34	NOAEL-red fox	1	0.34	57.43	0.00	42.57	2.06E-05
4-Methylphenol(p-cresol)	0	0.09	13.5	0.16512	7.2E-06	450	LOAEL-rat	100	4.5	0.00	47.93	52.07	1.60E-06
Acenaphthene	0.04343	0	0.34	0.00042	3.8E-08	8	LD50-rat	10000	0.0008	74.65	0.00	25.35	4.75E-05
Aldrin	0.00889	0	8	0.00039	1.47E-08	0.09	NOAEL-red fox	1	0.09	39.61	0.00	60.39	1.63E-07
Anthracene	0.50239	0	0.34	0.00269	3.89E-07	430	LD50-mouse	10000	0.043	84.34	0.00	15.66	9.06E-06
Antimony	0	0.11	0.15	0.00224	4.27E-06	300	LOAEL-rat	1000	0.3	0.00	98.81	1.19	1.42E-05
Arsenic	0	0.016	9	0.01957	1.06E-06	0.024	NOAEL-red fox	1	0.024	0.00	58.00	42.00	4.41E-05
Barium	0	0.4	120	6.52308	0.000163	0.95	LOAEL-mouse	100	0.0095	0.00	9.39	90.61	1.72E-02
Benz(a)anthracene	0.46839	0	0.125	0.00034	3.14E-07	2	dose-rodent	10000	0.0002	97.56	0.00	2.44	1.57E-03
Benzene	0	0.076	24	0.24788	8.54E-06	5.04	NOAEL-red fox	1	5.04	0.00	34.12	65.88	1.69E-06
Benzo(a)pyrene	0.37452	0	0.342	0.00055	2.57E-07	10	dose-mouse	10000	0.001	95.17	0.00	4.83	2.57E-04
Benzo(b)fluoranthene	0.40001	0	0.32	0.00058	2.75E-07	40	dose-mouse	10000	0.004	95.23	0.00	4.77	6.86E-05
Benzo(g,h,i)perylene	0.19377	0	0.34	0.00025	1.32E-07	0.8	dose-mouse	10000	0.00008	95.66	0.00	4.34	1.66E-03
Benzo(k)fluoranthene	0.40315	0	0.34	0.00062	2.78E-07	72	dose-rodent	10000	0.0072	94.95	0.00	5.05	3.86E-05
Benzoic acid	0.06847	0.068	21	0.76524	2E-05	1940	LD50-mouse	10000	0.194	0.22	13.02	86.75	1.03E-04
Benzyl alcohol	0	0.0075	4	0.00408	3.8E-07	1230	LD50-rat	10000	0.123	0.00	75.65	24.35	3.09E-06
beta-BHC	0	0.00003	4.2	1.7E-05	1.54E-09	0.17	NOAEL-red fox	1	0.17	0.00	74.74	25.26	9.05E-09
bis(2-Ethylhexyl)phthalate	0.86132	0	57	0.5004	1.19E-05	3.5	NOAEL-red fox	1	3.5	4.72	0.00	95.28	3.41E-06
Cadmium	0.49123	0	21	0.18417	4.5E-06	19.7	NOAEL-rat	10	1.97	7.14	0.00	92.86	2.28E-06
Chrysene	0.56569	0	0.07	0.00023	3.75E-07	99	dose-rodent	10000	0.0099	98.62	0.00	1.38	3.79E-05
Cobalt	0	0.016	40	0.08697	2.59E-06	13.25	LOAEL-rat	100	0.1325	0.00	23.71	76.29	1.95E-05
delta-BHC	0	0.000031	4.2	1.8E-05	1.59E-09	0.01	NOAEL-red fox	1	0.01	0.00	74.74	25.26	1.59E-07
Dibenz(a,h)anthracene	0.12471	0	0.34	0.00015	8.49E-08	0.01	dose-rodent	10000	0.000001	95.98	0.00	4.02	8.49E-02
Dieldrin	0.21465	0	8	0.03115	8.47E-07	0.01	NOAEL-red fox	1	0.01	16.56	0.00	83.44	8.47E-05
Endosulfan I	0.00487	0	59	0.00921	2.12E-07	0.07	NOAEL-red fox	1	0.07	1.50	0.00	98.50	3.03E-06
Endosulfan II	0.00108	0	59	0.00298	6.83E-08	0.07	NOAEL-red fox	1	0.07	1.03	0.00	98.97	9.76E-07
Endosulfan sulfate	0.00205	0	59	0.00476	1.09E-07	0.07	NOAEL-red fox	1	0.07	1.22	0.00	98.78	1.56E-06
Endrin	0.02414	0	8	0.00134	4.63E-08	0.02	NOAEL-red fox	1	0.02	34.10	0.00	65.90	2.31E-06

Table K-18
Waste Accumulation Area
Ecological Quotients for the Red Fox

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	MV BAF	Conc in MVs mg/kg	Red Fox Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ MV	Total EQ
Endrin aldehyde	0.00119	0	8	0.00072	1.72E-08	0.02	NOAEL-red fox	1	0.02	4.54	0.00	95.46	8.58E-07
Ethylbenzene	0	0.003	37.5	0.01529	4.62E-07	3500	LD50-rat	10000	0.35	0.00	24.89	75.11	1.32E-06
Fluoranthene	1.31596	0.00018	0.08	0.00106	8.91E-07	2000	LD50-rat	10000	0.2	96.51	0.77	2.71	4.46E-06
Fluorene	0.03558	0.0034	0.34	0.00042	1.63E-07	8.6	dose-rat	10000	0.00086	14.26	79.93	5.80	1.90E-04
gamma-BHC	0.00831	0	4.2	0.00216	5.44E-08	3.44	NOAEL-red fox	1	3.44	9.99	0.00	90.01	1.58E-08
Heptachlor	0.00026	0	10	1.7E-05	5.44E-10	0.34	NOAEL-red fox	1	0.34	30.97	0.00	69.03	1.60E-09
Heptachlor epoxide	0.00141	0.00043	10	0.00068	3.28E-08	0.34	NOAEL-red fox	1	0.34	2.81	50.28	46.91	9.64E-08
Indeno(1,2,3-cd)pyrene	0.17547	0	0.34	0.00023	1.2E-07	72	dose-rodent	10000	0.0072	95.66	0.00	4.34	1.67E-05
Lead	184.158	0	0.42	0.66004	0.000135	3.44	NOAEL-red fox	1	3.44	88.93	0.00	11.07	3.94E-05
Manganese	0	6	12	9.78462	0.000452	140	LOAEL-mouse	100	1.4	0.00	50.88	49.12	3.23E-04
Methoxychlor	0.00174	0	113	0.00167	3.91E-08	60	LOAEL-rat	100	0.6	2.91	0.00	97.09	6.51E-08
Naphthalene	0.00809	0.049	0.34	0.00244	1.94E-06	300	LOAEL-mouse	100	3	0.27	96.88	2.85	6.46E-07
Phenanthrene	0.65254	0.0013	0.12	0.00135	5.07E-07	700	LD50-mouse	10000	0.07	84.13	9.83	6.04	7.24E-06
Pyrene	0.81395	0.00021	0.34	0.00278	6.03E-07	69	LD50-mouse	10000	0.0069	88.21	1.33	10.45	8.74E-05
Toluene	0	0.06	20	0.16308	6E-06	4.9	NOAEL-red fox	1	4.9	0.00	38.33	61.67	1.22E-06
Xylene (total)	0	0.057	1.9	0.01472	2.52E-06	0.39	NOAEL-red fox	1	0.39	0.00	86.74	13.26	6.46E-06
Zinc	0	0.02	0.6	0.00163	8.04E-07	68.88	NOAEL-red fox	1	68.88	0.00	95.39	4.61	1.17E-08

Red Fox constants:

Food Ingestion Rate (FI):	kg/day	0.268
Soil Ingestion Fraction (S):	unitless	0.028
Water Ingestion Rate (WI):	L/day	0.44
Food Ingestion Fraction (F):	unitless	0.972
Body Weight (BW):	kg	5.25
Home Range:	acres	1771
Site Area:	acres	0.81
Home Range Fraction (HR):	unitless	0.000457

a = no toxicity data available
EQ red fox = red fox intake/toxicity benchmark
Red fox intake = (HR/BW) x [(Conc in MV x FI x F) + (Conc in soil x FI x S) + (Conc in water x WI)]
Conc in MV = BAF x Meadow vole intake

Table K-19
Waste Accumulation Area
Ecological Quotients for Terrestrial Invertebrates

Chemical	Conc in Soil mg/kg	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
2-Methylnaphthalene	0.016256				#DIV/0!	#DIV/0!
4,4'-DDD	4.609099				#DIV/0!	#DIV/0!
4,4'-DDE	0.349118				#DIV/0!	#DIV/0!
4,4'-DDT	6.167432				#DIV/0!	#DIV/0!
Acenaphthene	0.043431				#DIV/0!	#DIV/0!
Aldrin	0.008893				#DIV/0!	#DIV/0!
Anthracene	0.50239				#DIV/0!	#DIV/0!
Benz(a)anthracene	0.468389				#DIV/0!	#DIV/0!
Benzo(a)pyrene	0.374521	1	LC50-sandworm	10	0.1	3.75E+00
Benzo(b)fluoranthene	0.400009				#DIV/0!	#DIV/0!
Benzo(g,h,i)perylene	0.193772				#DIV/0!	#DIV/0!
Benzo(k)fluoranthene	0.403155				#DIV/0!	#DIV/0!
Benzoic acid	0.068473				#DIV/0!	#DIV/0!
bis(2-Ethylhexyl)phthalate	0.861321				#DIV/0!	#DIV/0!
Cadmium	0.491226				#DIV/0!	#DIV/0!
Chrysene	0.565687				#DIV/0!	#DIV/0!
Dibenz(a,h)anthracene	0.124713				#DIV/0!	#DIV/0!
Dieldrin	0.214648				#DIV/0!	#DIV/0!
Endosulfan I	0.004872				#DIV/0!	#DIV/0!
Endosulfan II	0.001078				#DIV/0!	#DIV/0!
Endosulfan sulfate	0.002048				#DIV/0!	#DIV/0!
Endrin	0.024138				#DIV/0!	#DIV/0!
Endrin aldehyde	0.001192				#DIV/0!	#DIV/0!
Fluoranthene	1.31596				#DIV/0!	#DIV/0!
Fluorene	0.035575	173	LC50-earthworm	10	17.3	2.06E-03
gamma-BHC	0.008314	0.008	LC50-insect	10	0.0008	1.04E+01
Heptachlor	0.000258				#DIV/0!	#DIV/0!
Heptachlor epoxide	0.00141				#DIV/0!	#DIV/0!
Indeno(1,2,3-cd)pyrene	0.175465				#DIV/0!	#DIV/0!
Lead	184.1576				#DIV/0!	#DIV/0!
Methoxychlor	0.001736				#DIV/0!	#DIV/0!
Naphthalene	0.008091	3.8	LC50-sandworm	10	0.38	2.13E-02
Phenanthrene	0.652541	6	LC50-sandworm	10	0.6	1.09E+00
Pyrene	0.813953				#DIV/0!	#DIV/0!

a = no toxicity data available

EQ invertebrate = Concentration in soil/toxicity benchmark

Table K-20
Waste Accumulation Area
Ecological Quotients for the Robin

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	Invert Uptake Factor	Conc in Invert mg/kg	Robin Intake mg/kg	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Invert	Total EQ
1,2-Dichloroethane	0	0.00042	2	0	1.16E-05	725	LD50-rat	10000	0.0725	0	100	0	1.60E-04
2-Methylnaphthalene	0.016256	0.07	0.342	0.005559	0.002213	1630	LD50-rat	10000	0.163	3.208221	87.33888	9.452898	1.36E-02
2-Methylphenol(o-cresol)	0	0.022	17.78	0	0.000608	606	NOAEL-vole	10	60.6	0	100	0	1.00E-05
4,4'-DDD	4.609099	0.00025	5	23.0455	0.887367	0.00099	NOAEL-robin	1	0.00099	2.268743	0.000778	97.73048	8.96E+02
4,4'-DDE	0.349118	0.000023	5	1.745589	0.067214	0.00099	NOAEL-robin	1	0.00099	2.268739	0.000945	97.73032	6.79E+01
4,4'-DDT	6.167432	0	5	30.83716	1.187376	0.00099	NOAEL-robin	1	0.00099	2.268761	0	97.73124	1.20E+03
4-Methylphenol(p-cresol)	0	0.09	13.5	0	0.002485	450	LOAEL-rat	100	4.5	0	100	0	5.52E-04
Acenaphthene	0.043431	0	0.34	0.014767	0.000745	8	LD50-rat	10000	0.0008	25.45027	0	74.54973	9.32E-01
Aldrin	0.008893	0	8	0.071145	0.002716	6.59	LD50-bobwhite	100	0.0659	1.430143	0	98.56986	4.12E-02
Anthracene	0.50239	0	a	a	a	a	a	a	a	a	a	a	a
Antimony	0	0.11	0.15	0	0.003038	300	LOAEL-rat	100	3	0	100	0	1.01E-03
Arsenic	0	0.016	9	0	0.000442	47.6	LD50-quail	10000	0.00476	0	100	0	9.28E-02
Barium	0	0.4	120	0	0.011045	10.77	NOAEL-vole	10	1.077	0	100	0	1.03E-02
Benz(a)anthracene	0.468389	0	0.125	0.058549	0.004249	180	dose-rat	10000	0.018	48.14815	0	51.85185	2.36E-01
Benzene	0	0.076	24	0	0.002099	930	LD50-rat	10000	0.093	0	100	0	2.26E-02
Benzo(a)pyrene	0.374521	0	0.342	0.128086	0.006456	0.881	NOAEL-vole	10	0.0881	25.33915	0	74.66085	7.33E-02
Benzo(b)fluoranthene	0.400009	0	0.32	0.128003	0.006564	15	dose-chicken	10000	0.0015	26.61753	0	73.38247	4.38E+00
Benzo(g,h,i)perylene	0.193772	0	a	a	a	a	a	a	a	a	a	a	a
Benzo(k)fluoranthene	0.403155	0	a	a	a	a	a	a	a	a	a	a	a
Benzoic acid	0.068473	0.068	21	1.437939	0.056288	1940	LD50-rat	10000	0.194	0.53	3.34	96.13	2.90E-01
Benzyl alcohol	0	0.0075	4	0	0.000207	1230	LD50-rat	10000	0.123	0.00	100.00	0.00	1.68E-03
beta-BHC	0	0.00003	4.2	0	8.28E-07	0.702	NOAEL-robin	1	0.702	0.00	100.00	0.00	1.18E-06
bis(2-Ethylhexyl)phthalate	0.861321	0	57	49.09529	1.851273	1.39	NOAEL-robin	1	1.39	0.20	0.00	99.80	1.33E+00
Cadmium	0.491226	0	21	10.31575	0.390339	19.7	NOAEL-rat	10	1.97	0.55	0.00	99.45	1.98E-01
Chrysene	0.565687	0	0.07	0.039598	0.003961	99	dose-rodent	10000	0.0099	62.38	0.00	37.62	4.00E-01
Cobalt	0	0.016	40	0	0.000442	5.7	LOAEL-mouse	100	0.057	0.00	100.00	0.00	7.75E-03
delta-BHC	0	0.000031	4.2	0	8.56E-07	0.702	NOAEL-robin	1	0.702	0.00	100.00	0.00	1.22E-06
Dibenz(a,h)anthracene	0.124713	0	a	a	a	a	a	a	a	a	a	a	a
Dieldrin	0.214648	0	8	1.717186	0.065557	0.139	NOAEL-robin	1	0.139	1.43	0.00	98.57	4.72E-01
Endosulfan I	0.004872	0	59	0.28746	0.010839	17.2	NOAEL-robin	1	17.2	0.20	0.00	99.80	6.30E-04
Endosulfan II	0.001078	0	59	0.063584	0.002397	17.2	NOAEL-robin	1	17.2	0.20	0.00	99.80	1.39E-04
Endosulfan sulfate	0.002048	0	59	0.120838	0.004556	17.2	NOAEL-robin	1	17.2	0.20	0.00	99.80	2.65E-04
Endrin	0.024138	0	8	0.193105	0.007372	0.73	NOAEL-robin	1	0.73	1.43	0.00	98.57	1.01E-02
Endrin aldehyde	0.001192	0	8	0.009534	0.000364	0.73	NOAEL-robin	1	0.73	1.43	0.00	98.57	4.99E-04
Ethylbenzene	0	0.003	37.5	0	8.28E-05	3500	LD50-rat	10000	0.35	0.00	100.00	0.00	2.37E-04
Fluoranthene	1.31596	0.00018	0.08	0.105277	0.009715	2000	LD50-rat	10000	0.2	59.17	0.05	40.78	4.86E-02
Fluorene	0.035575	0.0034	a	a	a	a	a	a	a	a	a	a	a
gamma-BHC	0.008314	0	4.2	0.034919	0.00135	4.66	NOAEL-robin	1	4.66	2.69	0.00	97.31	2.90E-04
Heptachlor	0.000258	0	10	0.002578	9.81E-05	92	LD50-bobwhite	3000	0.03066667	1.15	0.00	98.85	3.20E-03

Table K-20
Waste Accumulation Area
Ecological Quotients for the Robin

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	Invert Uptake Factor	Conc in Invert mg/kg	Robin Intake mg/kg	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Invert	Total EQ
Heptachlor epoxide	0.00141	0.00043	10	0.014101	0.000549	92	LD50-bobwhite	3000	0.03066667	1.12	2.16	96.71	1.79E-02
Indeno(1,2,3-cd)pyrene	0.175465	0	a	a	a	a	a	a	a	a	a	a	a
Lead	184.1576	0	0.42	77.34621	3.715007	500	dose-quail	100	5	21.65	0.00	78.35	7.43E-01
Manganese	0	6	12	0	0.165682	174.44	NOAEL-vole	10	17.444	0.00	100.00	0.00	9.50E-03
Methoxychlor	0.001736	0	113	0.196213	0.007391	2000	LD50-grouse	100	20	0.10	0.00	99.90	3.70E-04
Naphthalene	0.008091	0.049	0.34	0.002751	0.001492	4000	dose-mallard	10000	0.4	2.37	90.69	6.94	3.73E-03
Phenanthrene	0.652541	0.0013	0.12	0.078305	0.005833	4000	dose-mallard	10000	0.4	48.87	0.62	50.52	1.46E-02
Pyrene	0.813953	0.00021	a	a	a	a	a	a	a	a	a	a	a
Toluene	0	0.06	20	0	0.001657	22.9	NOAEL-vole	10	2.29	0.00	100.00	0.00	7.24E-04
Xylene (total)	0	0.057	1.9	0	0.001574	1.82	NOAEL-vole	10	0.182	0.00	100.00	0.00	8.65E-03
Zinc	0	0.02	0.6	0	0.000552	317.19	NOAEL-vole	10	31.719	0.00	100.00	0.00	1.74E-05

Robin Constants:

Food Ingestion Rate (FI):	kg/day	0.01597
Soil Ingestion Fraction (S):	unitless	0.104
Water Ingestion Rate (WI):	L/day	0.0105
Food Ingestion Fraction (F):	unitless	0.896
Body Weight (BW):	kg	0.077
Home Range:	acres	2
Site Area:	acres	0.81
Home Range Fraction (HR):	unitless	0.405
Time on Site:	months	6

a = no toxicity data available
EQ robin = robin intake/toxicity benchmark
Robin intake = (HR/BW) x 0.5 [(Conc in invert x FI x F) + (Conc in soil x FI x S) + (Conc in water x WI)]
Conc in invert = BAF x Conc in soil

Table K-21
Waste Accumulation Area
Ecological Quotients for the Kestrel

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	Robin BAF	Conc in Robin mg/kg	Kestrel Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Robin	Total EQ
1,2-Dichloroethane	0	0.00042	2	2.32E-05	4.13E-08	725	LD50-rat	10000	0.0725	0.00	96.25	3.75	5.70E-07
2-Methylnaphthalene	0.016256	0.07	0.342	0.0007569	6.8E-06	1630	LD50-rat	10000	0.163	1.77	97.49	0.74	4.17E-05
2-Methylphenol(o-cresol)	0	0.022	17.78	0.0108014	2.8E-06	606	NOAEL-vole	10	60.6	0.00	74.30	25.70	4.63E-08
4,4'-DDD	4.609099	0.00025	5	4.4368347	0.00033	0.00041	NOAEL-hawk	1	0.00041	10.35	0.01	89.65	8.05E-01
4,4'-DDE	0.349118	0.000023	5	0.33607	2.5E-05	0.00041	NOAEL-hawk	1	0.00041	10.35	0.01	89.64	6.10E-02
4,4'-DDT	6.167432	0	5	5.9368792	0.000442	0.00041	NOAEL-hawk	1	0.00041	10.35	0.00	89.65	1.08E+00
4-Methylphenol(p-cresol)	0	0.09	13.5	0.0335506	1.08E-05	450	LOAEL-rat	100	4.5	0.00	79.20	20.80	2.39E-06
Acenaphthene	0.043431	0	0.34	0.0002534	3.39E-07	8	LD50-rat	10000	0.0008	95.01	0.00	4.99	4.24E-04
Aldrin	0.008893	0	8	0.0217288	1.52E-06	0.0086	NOAEL-fox	10	0.00086	4.35	0.00	95.65	1.76E-03
Anthracene	0.50239	0	a	a	a	a	a	a	a	a	a	a	a
Antimony	0	0.11	0.15	0.0004556	1.04E-05	300	LOAEL-rat	100	3	0.00	99.71	0.29	3.48E-06
Arsenic	0	0.016	9	0.0039764	1.78E-06	47.6	LD50-quail	10000	0.00476	0.00	85.10	14.90	3.74E-04
Barium	0	0.4	120	1.3254545	0.000126	10.77	NOAEL-vole	10	1.077	0.00	29.99	70.01	1.17E-04
Benz(a)anthracene	0.468389	0	0.125	0.0005311	3.51E-06	180	dose-rat	10000	0.018	98.99	0.00	1.01	1.95E-04
Benzene	0	0.076	24	0.0503673	1.06E-05	5.04	NOAEL-fox	10	0.504	0.00	68.17	31.83	2.09E-05
Benzo(a)pyrene	0.374521	0	0.342	0.0022079	2.92E-06	0.191	NOAEL-fox	10	0.0191	94.96	0.00	5.04	1.53E-04
Benzo(b)fluoranthene	0.400009	0	0.32	0.0021005	3.11E-06	15	dose-chicken	10000	0.0015	95.49	0.00	4.51	2.07E-03
Benzo(g,h,i)perylene	0.193772	a	a	a	a	a	a	a	a	a	a	a	a
Benzo(k)fluoranthene	0.403155	a	a	a	a	a	a	a	a	a	a	a	a
Benzoic acid	0.068473	0.068	21	1.1820499	8.58E-05	1940	LD50-rat	10000	0.194	0.59	7.50	91.90	4.42E-04
Benzyl alcohol	0	0.0075	4	0.0008284	7.65E-07	1230	LD50-rat	10000	0.123	0.00	92.78	7.22	6.22E-06
beta-BHC	0	0.00003	4.2	3.479E-06	3.07E-09	0.289	NOAEL-hawk	1	0.289	0.00	92.45	7.55	1.06E-08
bis(2-Ethylhexyl)phthalate	0.861321	0	57	105.52258	0.007046	0.78	NOAEL-hawk	1	0.78	0.09	0.00	99.91	9.03E-03
Cadmium	0.491226	0	21	8.1971193	0.000551	19.7	NOAEL-rat	100	0.197	0.66	0.00	99.34	2.79E-03
Chrysene	0.565687	0	0.07	0.0002773	4.21E-06	99	dose-rodent	10000	0.0099	99.56	0.00	0.44	4.25E-04
Cobalt	0	0.016	40	0.0176727	2.69E-06	5.7	LOAEL-mouse	100	0.057	0.00	56.24	43.76	4.73E-05
delta-BHC	0	0.000031	4.2	3.595E-06	3.18E-09	0.289	NOAEL-hawk	1	0.289	0.00	92.45	7.55	1.10E-08
Dibenz(a,h)anthracene	0.124713	a	a	a	a	a	a	a	a	a	a	a	a
Dieldrin	0.214648	0	8	0.5244575	3.66E-05	0.058	NOAEL-hawk	1	0.058	4.35	0.00	95.65	6.31E-04
Endosulfan I	0.004872	0	59	0.6394843	4.27E-05	7.1	NOAEL-hawk	1	7.1	0.08	0.00	99.92	6.01E-06
Endosulfan II	0.001078	0	59	0.1414499	9.44E-06	7.1	NOAEL-hawk	1	7.1	0.08	0.00	99.92	1.33E-06
Endosulfan sulfate	0.002048	0	59	0.2688165	1.79E-05	7.1	NOAEL-hawk	1	7.1	0.08	0.00	99.92	2.53E-06
Endrin	0.024138	0	8	0.0589775	4.11E-06	0.302	NOAEL-hawk	1	0.302	4.35	0.00	95.65	1.36E-05
Endrin aldehyde	0.001192	0	8	0.002912	2.03E-07	0.302	NOAEL-hawk	1	0.302	4.35	0.00	95.65	6.73E-07
Ethylbenzene	0	0.003	37.5	0.0031065	4.91E-07	3500	LD50-rat	10000	0.35	0.00	57.82	42.18	1.40E-06
Fluoranthene	1.31596	0.00018	0.08	0.0007772	9.82E-06	2000	LD50-rat	10000	0.2	99.30	0.17	0.53	4.91E-05
Fluorene	0.035575	a	a	a	a	a	a	a	a	a	a	a	a
gamma-BHC	0.008314	0	4.2	0.0056715	4.4E-07	1.92	NOAEL-hawk	1	1.92	14.01	0.00	85.99	2.29E-07
Heptachlor	0.000258	0	10	0.0009814	6.74E-08	1.5	dose-kestrel	10	0.15	2.84	0.00	97.16	4.49E-07

Table K-21
Waste Accumulation Area
Ecological Quotients for the Kestrel

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	Robin BAF	Conc in Robin mg/kg	Kestrel Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Robin	Total EQ
Heptachlor epoxide	0.00141	0.00043	10	0.0054867	4.17E-07	1.5	dose-kestrel	10	0.15	2.51	9.76	87.74	2.78E-06
Indeno(1,2,3-cd)pyrene	0.175465	a	a	a	a	a	a	a	a	a	a	a	a
Lead	184.1576	0	0.42	1.5603029	0.001469	125	dose-kestrel	10	12.5	92.91	0.00	7.09	1.18E-04
Manganese	0	6	12	1.9881818	0.000701	37.88	NOAEL-fox	10	3.788	0.00	81.07	18.93	1.85E-04
Methoxychlor	0.001736	0	113	0.8352178	5.57E-05	2000	LD50-grouse	10000	0.2	0.02	0.00	99.98	2.79E-04
Naphthalene	0.008091	0.049	0.34	0.0005073	4.73E-06	4000	dose-mallard	10000	0.4	1.27	98.02	0.71	1.18E-05
Phenanthrene	0.652541	0.0013	0.12	0.0006999	5.01E-06	4000	dose-mallard	10000	0.4	96.61	2.46	0.93	1.25E-05
Pyrene	0.813953	a	a	a	a	a	a	a	a	a	a	a	a
Toluene	0	0.06	20	0.0331364	7.89E-06	4.9	NOAEL-fox	10	0.49	0.00	71.99	28.01	1.61E-05
Xylene (total)	0	0.057	1.9	0.0029906	5.6E-06	0.394	NOAEL-fox	10	0.0394	0.00	96.44	3.56	1.42E-04
Zinc	0	0.02	0.6	0.0003314	1.92E-06	68.88	NOAEL-fox	10	6.888	0.00	98.85	1.15	2.78E-07

Kestrel constants:

Food Ingestion Rate (FI):	kg/day	0.01096
Soil Ingestion Fraction (S):	unitless	0.1
Water Ingestion Rate (WI):	L/day	0.014
Food Ingestion Fraction (F):	unitless	0.9
Body Weight (BW):	kg	0.12
Home Range:	acres	499
Site Area:	acres	0.81
Home Range Fraction (HR):	unitless	0.001623
Time on site:	months	6

a = no toxicity data available
EQ kestrel = kestrel intake/ toxicity benchmark
Kestrel intake = (HR/BW) x 0.5 x [(Conc in sparrow x FI x F) + (Conc in soil x FI x S) + (Conc in water x WI)]
Conc in sparrow = BAF x sparrow intake

Table K-22
Million Gallon Hill
Ecological Quotients for the Northern Pike from Discharged Groundwater

Chemical	Conc in Water mg/L	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity enchmar	Total EQ
1,1-Dichloroethane	8.88E-10	202	LC50-guppy	6000	0.0336667	2.64E-08
1,1-Dichloroethene	3.78E-11	11.6	AWQC	1	11.6	3.26E-12
1,2-Dichloroethane	1.23E-07	20	AWQC	1	20	6.16E-09
2-Butanone (MEK)	2.72E-42	5600	LC50-mosquito fish	10000	0.56	4.86E-42
2-Methylnaphthalene	2.67E-04	2	LC50-minnow	6000	0.0003333	8.01E-01
2-Methylphenol(o-cresol)	2.77E-44	0.15	AWQC	1	0.15	1.85E-43
4,4'-DDD	3.32E-08	0.000001	AWQC	1	0.000001	3.32E-02
4,4'-DDE	1.55E-08	0.000001	AWQC	1	0.000001	1.55E-02
4,4'-DDT	5.28E-09	0.000001	AWQC	1	0.000001	5.28E-03
4-Methylphenol/3-Methylphenol	1.32E-05	0.15	AWQC	1	0.15	8.77E-05
Acenaphthene	5.04E-09	0.52	AWQC	1	0.52	9.69E-09
Acetone	6.12E-42	7032	LC50-guppy	10000	0.7032	8.71E-42
Aldrin	1.25E-09	0.0000019	AWQC	1	0.0000019	6.59E-04
alpha-BHC	3.39E-10	0.032	EC-guppy	10000	0.0000032	1.06E-04
Barium	3.42E-05	68	LC50-daphnia	10000	0.0068	5.02E-03
Benzene	1.06E-07	5.3	AWQC	10	0.53	2.00E-07
beta-BHC	4.54E-10	0.032	EC-guppy	10000	0.0000032	1.42E-04
bis(2-Ethylhexyl)phthalate	3.26E-08	540	LC50-trout	10000	0.054	6.04E-07
Bromochloromethane	5.10E-05	a	a	a	a	a
Chloroethane	7.29E-18	a	a	a	a	a
Chloromethane	2.50E-11	27	LC50-silverside	10000	0.0027	9.26E-09
cis-1,2-Dichloroethene	5.70E-05	11.6	AWQC	1	11.6	4.91E-06
Dibenzofuran	1.92E-21	0.0001	dose-pike	100	0.000001	1.92E-15
Dibromomethane	9.02E-12	a	a	a	a	a
Dieldrin	1.64E-09	0.0000019	AWQC	1	0.0000019	8.61E-04
Endosulfan sulfate	1.79E-09	0.0000056	AWQC	1	0.0000056	3.20E-04
Endrin aldehyde	1.18E-09	0.0000023	AWQC	1	0.0000023	5.12E-04
Ethylbenzene	2.20E-07	42.3	LC100-minnow	10000	0.00423	5.21E-05
Fluorene	2.01E-10	0.5	LC50-bluegill	10000	0.00005	4.02E-06
gamma-BHC	3.73E-10	0.023	LC50-salmon	10000	0.0000023	1.62E-04
Heptachlor	2.21E-47	0.0000038	AWQC	1	0.0000038	5.81E-42
Heptachlor epoxide	2.55E-09	0.0000038	AWQC	1	0.0000038	6.70E-04
Lead	3.10E-06	0.0032	AWQC	1	0.0032	9.67E-04
Methylene chloride	1.83E-15	193	LC50-minnow	10000	0.0193	9.47E-14
Naphthalene	1.14E-06	0.62	AWQC	1	0.62	1.84E-06
Phenanthrene	8.75E-08	0.0063	AWQC	1	0.0063	1.39E-05
Phenol	3.26E-79	2.56	AWQC	1	2.56	1.27E-79
Toluene	3.82E-15	17.5	AWQC	10	1.75	2.18E-15
trans-1,2-Dichloroethene	4.11E-06	11.6	AWQC	1	11.6	3.54E-07
Trichloroethene	7.92E-05	21.9	AWQC	1	21.9	3.62E-06
Vinyl Chloride	1.48E-08	388	EC50-pike	100	3.88	3.82E-09
Xylene (total)	2.98E-04	13.5	LC50-trout	100	0.135	2.21E-03

a = no toxicity information available

EQ pike = concentration in water/toxicty benchmark

Concentration in water = modeled groundwater concentrations, at a 5-feet range from shoreline (see Appendix C)

Table K-23
Million Gallon Hill
Ecological Quotients for Aquatic Invertebrates at the Mudflats

Chemical	Conc in GW mg/L	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
1,1-Dichloroethane	9.83E-07	202	LC50-guppy	10000	0.0202	4.87E-05
1,1-Dichloroethene	1.11E-09	11.6	AWQC-acute	10	1.16	9.56E-10
1,2-Dichloroethane	3.28E-06	20	AWQC	1	20	1.64E-07
2-Butanone (MEK)	8.06E-39	2.12	LC50-daphnia	100	0.0212	3.80E-37
2-Methylnaphthalene	0.60661	1.1	LC50-shrimp	10000	0.00011	5.51E+03
2-Methylphenol(o-cresol)	4.29E-41	0.15	AWQC	1	0.15	2.86E-40
4,4'-DDD	6.36E-05	0.000001	AWQC	1	0.000001	6.36E+01
4,4'-DDE	9.11E-06	0.000001	AWQC	1	0.000001	9.11E+00
4,4'-DDT	0.002994	0.000001	AWQC	1	0.000001	2.99E+03
4-Methylphenol/3-Methylphenol	0.000463	0.15	AWQC	1	0.15	3.09E-03
Acenaphthene	1.49E-05	0.52	AWQC	1	0.52	2.87E-05
Acetone	1.81E-35	6190	LC50-mosquito	100	61.9	2.93E-37
Aldrin	3.8E-07	0.0000019	AWQC	1	0.0000019	2.00E-01
alpha-BHC	1.64E-07	0.1	EC50-daphnia	100	0.001	1.64E-04
Barium	0.011889	68	LC50-daphnia	100	0.68	1.75E-02
Benzene	1.57E-08	5.3	AWQC	1	5.3	2.96E-09
beta-BHC	1.61E-07	0.1	EC50-daphnia	100	0.001	1.61E-04
bis(2-Ethylhexyl)phthalate	2.53E-05	540	LC50-trout	1000	0.54	4.69E-05
Bromochloromethane	0.002521	a	a	a	a	a
Chloroethane	1.91E-14	a	a	a	a	a
Chloromethane	3.67E-12	27	LC50-fish	10000	0.0027	1.36E-09
cis-1,2-Dichloroethene	0.003583	11.6	AWQC-acute	10	1.16	3.09E-03
Dibenzofuran	5.69E-18	0.00000001	AWQC	1	0.00000001	5.69E-10
Dibromomethane	4.59E-12	a	a	a	a	a
Dieldrin	1.01E-06	0.0000019	AWQC	1	0.0000019	5.32E-01
Endosulfan sulfate	1.01E-06	0.0000056	AWQC	1	0.0000056	1.81E-01
Endrin aldehyde	2.82E-07	0.0000023	AWQC	1	0.0000023	1.22E-01
Ethylbenzene	0.000252	275	LC50-shrimp	10000	0.0275	9.17E-03
Fluorene	5.87E-07	1	LC50-shrimp	10000	0.0001	5.87E-03
gamma-BHC	4.62E-08	0.46	LC48-daphnia	100	0.0046	1.00E-05
Heptachlor	2.81E-103	0.0000038	AWQC	1	0.0000038	7.39E-98
Heptachlor epoxide	7.02E-07	0.0000038	AWQC	1	0.0000038	1.85E-01
Lead	0.00256	0.0032	AWQC	1	0.0032	8.00E-01
Methylene chloride	4.59E-12	224	LC50-daphnia	100	2.24	2.05E-12
Naphthalene	0.003271	0.62	AWQC	1	0.62	5.28E-03
Phenanthrene	0.000253	0.063	AWQC	1	0.063	4.02E-03
Phenol	9.46E-76	2.56	AWQC	1	2.56	3.69E-76
Toluene	6.12E-20	17.5	AWQC	1	17.5	3.50E-21
trans-1,2-Dichloroethene	0.000425	11.6	AWQC-acute	10	1.16	3.66E-04
Trichloroethene	0.000768	21.9	AWQC	1	21.9	3.50E-05
Vinyl Chloride	0.011006	388	EC50-pike	10000	0.0388	2.84E-01
Xylene (total)	0.046347	13	LC50-fish	10000	0.0013	3.57E+01

a = no toxicity data available
EQ = Concentration in water/toxicity benchmark
Concentration in water = modeled groundwater concentrations discharging to the shoreline (see Appendix C)

Table K-24
Million Gallon Hill
Ecological Quotients for the Spotted Sandpiper at the Mudflats

Chemical	Conc in GW mg/L	Insect Uptake Factor	Conc in Invert mg/kg	SSP Intake mg/kg-day	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Water	% EQ Invert.	Total EQ
1,1-Dichloroethane	9.83E-07	6.6	6.49E-06	6.24E-06	725	LD50-rat	10000	0.0725	94.33	5.67	8.61E-05
1,1-Dichloroethene	1.11E-09	2.5	2.77E-09	6.79E-09	3331	LOAEL-mouse	100	33.31	97.77	2.23	2.04E-10
1,2-Dichloroethane	3.28E-06	2	6.55E-06	2.00E-05	46.81	NOAEL-robin	1	46.81	98.21	1.79	4.27E-07
2-Butanone (MEK)	8.06E-39	0.98	7.90E-39	4.87E-38	1080	LOAEL-rat	100	10.8	99.12	0.88	4.51E-39
2-Methylnaphthalene	6.07E-01	1000	6.07E+02	3.67E+01	1630	LD50-rat	10000	60.6	9.90	90.10	6.06E-01
2-Methylphenol(o-cresol)	4.29E-41	18	7.73E-40	2.99E-40	606	NOAEL-vole	10	60.6	85.92	14.08	4.94E-42
4,4'-DDD	6.36E-05	12000	7.63E-01	4.20E-02	0.00032	NOAEL-heron	10	0.000032	0.91	99.09	1.31E+03
4,4'-DDE	9.11E-06	12000	1.09E-01	6.01E-03	0.00032	NOAEL-heron	10	0.000032	0.91	99.09	1.88E+02
4,4'-DDT	2.99E-03	12000	3.59E+01	1.98E+00	0.00032	NOAEL-heron	10	0.000032	0.91	99.09	6.18E+04
4-Methylphenol/3-Methylphenol	4.63E-04	18	8.34E-03	3.23E-03	606	NOAEL-vole	10	60.6	85.92	14.08	5.33E-05
Acenaphthene	1.49E-05	2.6	3.88E-05	9.15E-05	2000	dose-rat	10000	0.2	97.69	2.31	4.58E-04
Acetone	1.81E-35	0.69	1.25E-35	1.09E-34	40000	LD50-pheasant	10000	4	99.38	0.62	2.73E-35
Aldrin	3.80E-07	3140	1.19E-03	6.73E-05	0.045	NOAEL-heron	10	0.0045	3.38	96.62	1.49E-02
alpha-BHC	1.64E-07	1100	1.81E-04	1.08E-05	0.226	NOAEL-heron	10	0.0226	9.08	90.92	4.79E-04
Barium	1.19E-02	120	1.43E+00	1.49E-01	10.77	NOAEL-vole	10	1.077	47.79	52.21	1.38E-01
Benzene	1.57E-08	4.27	6.71E-08	9.77E-08	23.23	NOAEL-vole	10	2.323	96.26	3.74	4.21E-08
beta-BHC	1.61E-07	1460	2.35E-04	1.38E-05	0.226	NOAEL-heron	10	0.0226	7.00	93.00	6.09E-04
bis(2-Ethylhexyl)phthalate	2.53E-05	1000	2.53E-02	1.53E-03	1.39	NOAEL-robin	10	0.139	9.90	90.10	1.10E-02
Bromochloromethane	2.52E-03	a	a	a	a	a	a	a	a	a	a
Chloroethane	1.91E-14	a	a	a	a	a	a	a	a	a	a
Chloromethane	3.67E-12	2.88	1.06E-11	2.25E-11	500	LOAEL-mouse	100	5	97.44	2.56	4.51E-12
cis-1,2-Dichloroethene	3.58E-03	23	8.24E-02	2.59E-02	39.8	NOAEL-vole	10	3.98	82.68	17.32	6.52E-03
Dibenzofuran	5.69E-18	589	3.35E-15	2.17E-16	0.015	LD50-bobwhite	10000	0.0000015	15.72	84.28	1.44E-10
Dibromomethane	4.59E-12	a	a	a	a	a	a	a	a	a	a
Dieldrin	1.01E-06	2700	2.73E-03	1.55E-04	0.045	NOAEL-heron	10	0.0045	3.91	96.09	3.44E-02
Endosulfan sulfate	1.01E-06	59	5.96E-05	9.31E-06	17.22	NOAEL-robin	10	1.722	65.05	34.95	5.40E-06
Endrin aldehyde	2.82E-07	121	3.41E-05	3.54E-06	0.73	NOAEL-robin	10	0.073	47.58	52.42	4.85E-05
Ethylbenzene	2.52E-04	144	3.63E-02	3.49E-03	3500	LD50-rat	10000	0.35	43.27	56.73	9.97E-03
Fluorene	5.87E-07	5000	2.94E-03	1.64E-04	2000	LD50-rat	10000	0.2	2.15	97.85	8.18E-04
gamma-BHC	4.62E-08	319	1.47E-05	1.08E-06	4.66	NOAEL-robin	10	0.466	25.61	74.39	2.32E-06
Heptachlor	2.81E-103	20	5.62E-102	1.99E-102	92	LC50-quail	10000	0.0092	84.59	15.41	2.16E-100
Heptachlor epoxide	7.02E-07	20	1.40E-05	4.97E-06	92	LC50-quail	10000	0.0092	84.59	15.41	5.40E-04
Lead	2.56E-03	42	1.08E-01	2.12E-02	100	dose-gull	10000	0.01	72.34	27.66	2.12E+00
Methylene chloride	4.59E-12	2.3	1.06E-11	2.80E-11	8.49	LD50-chicken	10000	0.000849	97.95	2.05	3.30E-08
Naphthalene	3.27E-03	1000	3.27E+00	1.98E-01	4000	dose-mallard	10000	0.4	9.90	90.10	4.95E-01

Table K-24
Million Gallon Hill
Ecological Quotients for the Spotted Sandpiper at the Mudflats

Chemical	Conc in GW mg/L	Insect Uptake Factor	Conc in Invert mg/kg	SSP Intake mg/kg-day	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Water	% EQ Invert.	Total EQ
Phenanthrene	2.53E-04	325	8.23E-02	6.00E-03	700	LD50-mouse	10000	0.07	25.26	74.74	8.58E-02
Phenol	9.46E-76	20	1.89E-74	6.69E-75	980	Dose-rat	10000	0.098	84.59	15.41	6.83E-74
Toluene	6.12E-20	90	5.51E-18	6.67E-19	22.9	NOAEL-vole	10	2.29	54.96	45.04	2.91E-19
trans-1,2-Dichloroethene	4.25E-04	23	9.77E-03	3.08E-03	39.8	NOAEL-vole	10	3.98	82.68	17.32	7.73E-04
Trichloroethene	7.68E-04	17	1.30E-02	5.31E-03	1000	LOAEL-mouse	100	10	86.60	13.40	5.31E-04
Vinyl Chloride	1.10E-02	5.1	5.61E-02	6.90E-02	5.6	LOAEL-rat	100	0.056	95.56	4.44	1.23E+00
Xylene (total)	4.63E-02	80	3.71E+00	4.80E-01	1.82	NOAEL-vole	10	0.182	57.86	42.14	2.64E+00

Spotted Sandpiper Constants:		
Body weight (BW):	kg	0.047
Water Intake (WI):	L/day	0.67
Food Ingestion rate (FI):	kg/day	0.00744
Soil Ingestion fraction (S):	unitless	0.18
Food Ingestion fraction (F):	unitless	0.82
Home Range:	acres	2.5
Time on site:	months	5
Home Range Fraction (HR):	unitless	1
Site Area:	acres	6.26

EQ = sandpiper intake/toxicity benchmark

Intake = (HR/BW) x 0.42 x ((Conc in Invert x FI x FF) + (Conc in water x WI))

Conc. in Water = modeled groundwater concentrations discharged to the mudflats (see Appendix C)

a = no toxicity data available

Table K-25
Million Gallon Hill
Ecological Quotients for Terrestrial Plants

Chemical	Conc in Soil mg/kg	Tox Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Ecological Quotients
2-Methylnaphthalene	0.0311336				#DIV/0!	#DIV/0!
4,4'-DDD	0.0539197				#DIV/0!	#DIV/0!
4,4'-DDE	0.0149927				#DIV/0!	#DIV/0!
4,4'-DDT	0.1399645				#DIV/0!	#DIV/0!
4-Methyl-2-Pentanone(MIBK)	0.0013963				#DIV/0!	#DIV/0!
Acenaphthene	0.0135194				#DIV/0!	#DIV/0!
alpha-BHC	0.001298				#DIV/0!	#DIV/0!
Anthracene	0.0489641				#DIV/0!	#DIV/0!
Benz(a)anthracene	0.1469011				#DIV/0!	#DIV/0!
Benzo(a)pyrene	0.342895				#DIV/0!	#DIV/0!
Benzo(b)fluoranthene	3.702475				#DIV/0!	#DIV/0!
Benzo(g,h,i)perylene	0.1868993				#DIV/0!	#DIV/0!
Benzo(k)fluoranthene	0.5105341				#DIV/0!	#DIV/0!
beta-BHC	0.0028971				#DIV/0!	#DIV/0!
bis(2-Ethylhexyl)phthalate	0.1319043				#DIV/0!	#DIV/0!
Chrysene	0.3820001				#DIV/0!	#DIV/0!
Dibenzofuran	0.0133364				#DIV/0!	#DIV/0!
Dibutyl phthalate	0.0281606				#DIV/0!	#DIV/0!
Dieldrin	0.0015033				#DIV/0!	#DIV/0!
Endosulfan I	0.0019541				#DIV/0!	#DIV/0!
Endosulfan sulfate	0.0071415				#DIV/0!	#DIV/0!
Endrin aldehyde	0.0014874				#DIV/0!	#DIV/0!
Fluoranthene	0.5442095				#DIV/0!	#DIV/0!
Fluorene	0.0170268				#DIV/0!	#DIV/0!
gamma-BHC	0.0018575				#DIV/0!	#DIV/0!
Heptachlor	0.0017009				#DIV/0!	#DIV/0!
Indeno(1,2,3-cd)pyrene	0.1715847				#DIV/0!	#DIV/0!
Lead	1306.964784	50	LOEC	1	50	26.1392957
Methoxychlor	0.0000731				#DIV/0!	#DIV/0!
Methylene chloride	0.0306098				#DIV/0!	#DIV/0!
Naphthalene	0.022365				#DIV/0!	#DIV/0!
Phenanthrene	0.1639067				#DIV/0!	#DIV/0!
Pyrene	0.4244121				#DIV/0!	#DIV/0!

a = no toxicity data available
EQ plant = Concentration in soil/toxicity benchmark

Table K-26
Million Gallon Hill
Ecological Quotients for the Meadow Vole

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	log Kow	Plant Uptake Factor	Conc in Plants mg/kg	MV Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Plant	Total EQ
1,2-Dichloroethane	0	0.00042	1.45	5.62E+00	0.00E+00	5.71E-05	46.3	NOAEL-vole	1	46.3	0	100	0	1.23E-06
2-Methylnaphthalene	0.031134	0.07	3.86	2.27E-01	7.08E-03	0.010475	1630	LD50-rat	6000	0.27166667	0.896217	90.81346	8.290325	3.86E-02
2-Methylphenol (o-cresol)	0	0.022	1.95	2.89E+00	0.00E+00	0.00299	606	NOAEL-vole	1	606	0	100	0	4.93E-06
4,4'-DDD	0.05392	0.00025	6.2	1.01E-02	5.45E-04	0.000263	1.58	NOAEL-vole	1	1.58	61.74	12.90	25.36	1.67E-04
4,4'-DDE	0.014993	0.000023	7	3.48E-03	5.22E-05	5.47E-05	1.58	NOAEL-vole	1	1.58	82.59	5.71	11.70	3.46E-05
4,4'-DDT	0.139965	0	6.19	1.02E-02	1.43E-03	0.000598	1.58	NOAEL-vole	1	1.58	70.61	0.00	29.39	3.78E-04
4-Methyl-2-Pentanone(MIBK)	0.001396	0	0.72	1.49E+01	2.07E-02	0.002548	49.56	NOAEL-vole	1	49.56	0.17	0.00	99.83	5.14E-05
4-Methylphenol (p-cresol)	0	0.09	1.94	2.93E+00	0.00E+00	0.012231	450	LOAEL-rat	60	7.5	0.00	100.00	0.00	1.63E-03
Acenaphthene	0.013519	0	3.92	2.10E-01	2.84E-03	0.000389	2	dose-rat	6000	0.00033333	10.48	0.00	89.52	1.17E+00
alpha-BHC	0.001298	0	3.46	3.87E-01	5.03E-04	6.56E-05	3.17	NOAEL-vole	1	3.17	5.97	0.00	94.03	2.07E-05
Anthracene	0.048964	0	4.45	1.04E-01	5.08E-03	0.00077	430	LD50-rodent	6000	0.07166667	19.16	0.00	80.84	1.08E-02
Antimony	0	0.11	b	2.00E-01	0.00E+00	0.014949	300	LOAEL-rat	60	5	0.00	100.00	0.00	2.99E-03
Arsenic	0	0.016	b	4.00E-02	0.00E+00	0.002174	0.111	NOAEL-vole	1	0.111	0.00	100.00	0.00	1.96E-02
Barium	0	0.4	b	1.50E-01	0.00E+00	0.054359	10.77	NOAEL-vole	1	10.77	0.00	100.00	0.00	5.05E-03
Benz(a)anthracene	0.146901	0	5.6	2.24E-02	3.30E-03	0.000847	2	dose-rodent	6000	0.00033333	52.28	0.00	47.72	2.54E+00
Benzene	0	0.076	2.13	2.27E+00	0.00E+00	0.010328	23.23	NOAEL-vole	1	23.23	0.00	100.00	0.00	4.45E-04
Benzo(a)pyrene	0.342895	0	6.19	1.02E-02	3.51E-03	0.001464	10	LD-50-rodent	6000	0.00166667	70.61	0.00	29.39	8.79E-01
Benzo(b)fluoranthene	3.702475	0	6.06	1.22E-02	4.51E-02	0.01669	40	dose-rodent	6000	0.00666667	66.89	0.00	33.11	2.50E+00
Benzo(g,h,i)perylene	0.186899	0	6.5	6.78E-03	1.27E-03	0.000719	0.8	dose-mouse	6000	0.00013333	78.40	0.00	21.60	5.39E+00
Benzo(k)fluoranthene	0.510534	0	6.06	1.22E-02	6.21E-03	0.002301	72	dose-mouse	6000	0.012	66.89	0.00	33.11	1.92E-01
Benzoic acid	0	0.068	1.87	3.21E+00	0.00E+00	0.009241	1940	LD50-mouse	6000	0.32333333	0.00	100.00	0.00	2.86E-02
Benzyl alcohol	0	0.0075	1.1	8.96E+00	0.00E+00	0.001019	1580	LD50-mouse	6000	0.26333333	0.00	100.00	0.00	3.87E-03
beta-BHC	0.002897	0.00003	4.5	9.71E-02	2.81E-04	4.73E-05	3.17	NOAEL-vole	1	3.17	18.47	8.62	72.91	1.49E-05
bis(2-Ethylhexyl)phthalate	0.131904	0	4.88	5.85E-02	7.72E-03	0.001344	16.15	NOAEL-vole	1	16.15	29.58	0.00	70.42	8.32E-05
Chrysene	0.382	0	5.6	2.24E-02	8.58E-03	0.002203	99	dose-rodent	6000	0.0165	52.28	0.00	47.72	1.34E-01
Cobalt	0	0.016	b	2.00E-02	0.00E+00	0.002174	13.25	LOAEL-rat	60	0.22083333	0.00	100.00	0.00	9.85E-03
delta-BHC	0	0.000031	2.8	9.32E-01	0.00E+00	4.21E-06	3.17	NOAEL-vole	1	3.17	0.00	100.00	0.00	1.33E-06
Dibenzofuran	0.013336	0	6.53	6.51E-03	8.68E-05	5.09E-05	0.00032	NOAEL-vole	1	0.00032	79.06	0.00	20.94	1.59E-01
Dibutyl phthalate	0.028161	0	5.6	2.24E-02	6.32E-04	0.000162	484.69	NOAEL-vole	1	484.69	52.28	0.00	47.72	3.35E-07
Dieldrin	0.001503	0	4.32	1.23E-01	1.85E-04	2.73E-05	0.04	NOAEL-vole	1	0.04	16.62	0.00	83.38	6.82E-04
Endosulfan I	0.001954	0	3.83	2.37E-01	4.63E-04	6.26E-05	0.29	NOAEL-vole	1	0.29	9.41	0.00	90.59	2.16E-04
Endosulfan sulfate	0.007142	0	3.66	2.97E-01	2.12E-03	0.000281	0.29	NOAEL-vole	1	0.29	7.65	0.00	92.35	9.71E-04
Endrin aldehyde	0.001487	0	3.14	5.93E-01	8.82E-04	0.000113	0.081	NOAEL-vole	1	0.081	3.98	0.00	96.02	1.39E-03
Ethyl benzene	0	0.003	3.15	5.85E-01	0.00E+00	0.000408	408	dose-rat	6000	0.068	0.00	100.00	0.00	6.00E-03
Fluoranthene	0.54421	0.00018	4.89	5.78E-02	3.14E-02	0.00552	2000	dose-rat	6000	0.33333333	29.73	0.44	69.83	1.66E-02
Fluorene	0.017027	0.0034	4.17	1.51E-01	2.56E-03	0.000828	8.6	dose-rat	6000	0.00143333	6.20	55.82	37.98	5.78E-01
gamma-BHC	0.001858	0	3.3	4.79E-01	8.90E-04	0.000115	15.8	NOAEL-vole	1	15.8	4.88	0.00	95.12	7.26E-06
Heptachlor	0.001701	0	5.44	2.78E-02	4.72E-05	1.09E-05	1.58	NOAEL-vole	1	1.58	46.96	0.00	53.04	6.91E-06
Heptachlor epoxide	0	0.00043	5.4	2.93E-02	0.00E+00	5.84E-05	1.58	NOAEL-vole	1	1.58	0.00	100.00	0.00	3.70E-05
Indeno(1,2,3-cd)pyrene	0.171585	0	6.5	6.78E-03	1.16E-03	0.00066	72	dose-rodent	6000	0.012	78.40	0.00	21.60	5.50E-02
Lead	1306.965	0	b	4.50E-02	5.88E+01	11.15303	15.86	NOAEL-vole	1	15.86	35.34	0.00	64.66	7.03E-01
Manganese	0	6	b	2.50E-01	0.00E+00	0.815385	174.45	NOAEL-vole	1	174.45	0.00	100.00	0.00	4.67E-03
Methoxychlor	7.31E-05	0	5.08	4.48E-02	3.28E-06	6.22E-07	60	LOAEL-rat	60	1	35.41	0.00	64.59	6.22E-07

Table K-26
Million Gallon Hill
Ecological Quotients for the Meadow Vole

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	log Kow	Plant Uptake Factor	Conc in Plants mg/kg	MV Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Plant	Total EQ
Methylene chloride	0.03061	0	0.95	1.09E+01	3.35E-01	0.041145	11.59	NOAEL-vole	1	11.59	0.22	0.00	99.78	3.55E-03
Naphthalene	0.022365	0.049	3.29	4.86E-01	1.09E-02	0.008058	1780	LD50-rodent	6000	0.29666667	0.84	82.63	16.53	2.72E-02
Phenanthrene	0.163907	0.0013	4.38	1.14E-01	1.87E-02	0.002959	700	dose-mouse	6000	0.11666667	16.70	5.97	77.33	2.54E-02
Pyrene	0.424412	0.00021	4.9	5.70E-02	2.42E-02	0.004274	800	LD50-mouse	6000	0.13333333	29.94	0.67	69.39	3.21E-02
Toluene	0	0.06	2.69	1.08E+00	0.00E+00	0.008154	22.9	NOAEL-vole	1	22.9	0.00	100.00	0.00	3.56E-04
Xylene (total)	0	0.057	4.9	5.70E-02	0.00E+00	0.007746	1.82	NOAEL-vole	1	1.82	0.00	100.00	0.00	4.26E-03
Zinc	0	0.02	b	1.50E+00	0.00E+00	0.002718	317.19	NOAEL-vole	1	317.19	0.00	100.00	0.00	8.57E-06

Meadow Vole constants:		
Food Ingestion Rate (FI):	kg/day	0.0049
Soil Ingestion Fraction (S):	unitless	0.024
Water Ingestion Rate (WI):	L/day	0.0053
Food Ingestion Fraction (F):	unitless	0.976
Body Weight (BW):	kg	0.039
Home Range:	acres	0.34
Site Area:	acres	6.26
Home Range Fraction (HR):	unitless	1

a = no toxicity data available
b = Kow not applicable to metals

EQvole = vole intake/toxicity benchmark
Vole intake = (HR/BW) x [(Conc in plants x FI x F) + (Conc in soil x FI x S) + (Conc in water x WI)]
Conc in plants = Conc in soil x plant uptake factor

Table K-27
Million Gallon Hill
Ecological Quotients for the Red Fox

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	MV BAF	Conc in MVs mg/kg	Red Fox Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ MV	Total EQ
1,2-Dichloroethane	0	0.00042	2	0.00011	1.44E-07	10.06	NOAEL-red fox	1	10.06	0.00	86.14	13.86	1.44E-08
2-Methylnaphthalene	0.03113	0.07	0.342	0.00358	2.15E-05	1630	LD50-rat	10000	0.163	0.73	96.35	2.92	1.32E-04
2-Methylphenol (o-cresol)	0	0.022	17.78	0.05316	1.58E-05	131.6	NOAEL-red fox	1	131.6	0.00	41.14	58.86	1.20E-07
4,4'-DDD	0.05392	0.00025	5	0.00132	5.77E-07	0.34	NOAEL-red fox	1	0.34	47.18	12.83	40.00	1.70E-06
4,4'-DDE	0.01499	0.000023	5	0.00027	1.31E-07	0.34	NOAEL-red fox	1	0.34	58.02	5.22	36.77	3.84E-07
4,4'-DDT	0.13996	0	5	0.00299	1.23E-06	0.34	NOAEL-red fox	1	0.34	57.43	0.00	42.57	3.62E-06
4-Methyl-2-Pentanone(MIBK)	0.0014	0	2.1	0.00535	9.45E-07	10.76	NOAEL-red fox	1	10.76	0.75	0.00	99.25	8.79E-08
4-Methylphenol (p-cresol)	0	0.09	13.5	0.16512	5.56E-05	450	LOAEL-rat	100	4.5	0.00	47.93	52.07	1.24E-05
Acenaphthene	0.01352	0	0.34	0.00013	9.15E-08	8	LD50-rat	10000	0.0008	74.65	0.00	25.35	1.14E-04
alpha-BHC	0.0013	0	4.2	0.00028	5.49E-08	0.01	NOAEL-red fox	1	0.01	11.95	0.00	88.05	5.49E-06
Anthracene	0.04896	0	0.34	0.00026	2.93E-07	430	LD50-mouse	10000	0.043	84.34	0.00	15.66	6.82E-06
Antimony	0	0.11	0.15	0.00224	3.3E-05	300	LOAEL-rat	1000	0.3	0.00	98.81	1.19	1.10E-04
Arsenic	0	0.016	9	0.01957	8.17E-06	0.024	NOAEL-red fox	1	0.024	0.00	58.00	42.00	3.41E-04
Barium	0	0.4	120	6.52308	0.001263	0.95	LOAEL-mouse	100	0.0095	0.00	9.39	90.61	1.33E-01
Benz(a)anthracene	0.1469	0	0.125	0.00011	7.61E-07	2	dose-rodent	10000	0.0002	97.56	0.00	2.44	3.80E-03
Benzene	0	0.076	24	0.24788	6.6E-05	5.04	NOAEL-red fox	1	5.04	0.00	34.12	65.88	1.31E-05
Benzo(a)pyrene	0.3429	0	0.342	0.0005	1.82E-06	10	dose-mouse	10000	0.001	95.17	0.00	4.83	1.82E-03
Benzo(b)fluoranthene	3.70248	0	0.32	0.00534	1.96E-05	40	dose-mouse	10000	0.004	95.23	0.00	4.77	4.91E-03
Benzo(g,h,i)perylene	0.1869	0	0.34	0.00024	9.87E-07	0.8	dose-mouse	10000	0.00008	95.66	0.00	4.34	1.23E-02
Benzo(k)fluoranthene	0.51053	0	0.34	0.00078	2.72E-06	72	dose-rodent	10000	0.0072	94.95	0.00	5.05	3.77E-04
Benzoic acid	0	0.068	21	0.19406	5.42E-05	1940	LD50-mouse	10000	0.194	0.00	37.18	62.82	2.79E-04
Benzyl alcohol	0	0.0075	4	0.00408	2.94E-06	1230	LD50-rat	10000	0.123	0.00	75.65	24.35	2.39E-05
beta-BHC	0.0029	0.00003	4.2	0.0002	5.84E-08	0.17	NOAEL-red fox	1	0.17	25.08	15.23	59.69	3.43E-07
bis(2-Ethylhexyl)phthalate	0.1319	0	57	0.07663	1.41E-05	3.5	NOAEL-red fox	1	3.5	4.72	0.00	95.28	4.03E-06
Chrysene	0.382	0	0.07	0.00015	1.96E-06	99	dose-rodent	10000	0.0099	98.62	0.00	1.38	1.98E-04
Cobalt	0	0.016	40	0.08697	2E-05	13.25	LOAEL-rat	100	0.1325	0.00	23.71	76.29	1.51E-04
delta-BHC	0	0.000031	4.2	1.8E-05	1.23E-08	0.01	NOAEL-red fox	1	0.01	0.00	74.74	25.26	1.23E-06
Dibenzofuran	0.01334	0	5	0.00025	1.12E-07	0.00007	NOAEL-red fox	1	0.00007	60.17	0.00	39.83	1.60E-03
Dibutyl phthalate	0.02816	0	57	0.00926	1.77E-06	105.25	NOAEL-red fox	1	105.25	8.06	0.00	91.94	1.68E-08
Dieldrin	0.0015	0	8	0.00022	4.59E-08	0.01	NOAEL-red fox	1	0.01	16.56	0.00	83.44	4.59E-06
Endosulfan I	0.00195	0	59	0.00369	6.58E-07	0.07	NOAEL-red fox	1	0.07	1.50	0.00	98.50	9.40E-06
Endosulfan sulfate	0.00714	0	59	0.01661	2.95E-06	0.07	NOAEL-red fox	1	0.07	1.22	0.00	98.78	4.21E-05
Endrin aldehyde	0.00149	0	8	0.0009	1.66E-07	0.02	NOAEL-red fox	1	0.02	4.54	0.00	95.46	8.28E-06

Table K-27
Million Gallon Hill
Ecological Quotients for the Red Fox

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	MV BAF	Conc in MVs mg/kg	Red Fox Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ MV	Total EQ
Ethyl benzene	0	0.003	37.5	0.01529	3.57E-06	3500	LD50-rat	10000	0.35	0.00	24.89	75.11	1.02E-05
Fluoranthene	0.54421	0.00018	0.08	0.00044	2.88E-06	2000	LD50-rat	10000	0.2	95.46	1.85	2.69	1.44E-05
Fluorene	0.01703	0.0034	0.34	0.00028	1.14E-06	8.6	dose-rat	10000	0.00086	7.53	88.15	4.32	1.33E-03
gamma-BHC	0.00186	0	4.2	0.00048	9.39E-08	3.44	NOAEL-red fox	1	3.44	9.99	0.00	90.01	2.73E-08
Heptachlor	0.0017	0	10	0.00011	2.77E-08	0.34	NOAEL-red fox	1	0.34	30.97	0.00	69.03	8.16E-08
Heptachlor epoxide	0	0.00043	10	0.00058	2.3E-07	0.34	NOAEL-red fox	1	0.34	0.00	55.42	44.58	6.76E-07
Indeno(1,2,3-cd)pyrene	0.17158	0	0.34	0.00022	9.06E-07	72	dose-rodent	10000	0.0072	95.66	0.00	4.34	1.26E-04
Lead	1306.96	0	0.42	4.68427	0.007425	3.44	NOAEL-red fox	1	3.44	88.93	0.00	11.07	2.16E-03
Manganese	0	6	12	9.78462	0.003494	140	LOAEL-mouse	100	1.4	0.00	50.88	49.12	2.50E-03
Methoxychlor	7.3E-05	0	113	7E-05	1.27E-08	60	LOAEL-rat	100	0.6	2.91	0.00	97.09	2.12E-08
Methylene chloride	0.03061	0	2.3	0.09463	1.68E-05	2.51	NOAEL-red fox	1	2.51	0.92	0.00	99.08	6.67E-06
Naphthalene	0.02237	0.049	0.34	0.00274	1.51E-05	300	LOAEL-mouse	100	3	0.75	96.07	3.18	5.04E-06
Phenanthrene	0.16391	0.0013	0.12	0.00036	1.28E-06	700	LD50-mouse	10000	0.07	64.92	30.19	4.88	1.82E-05
Pyrene	0.42441	0.00021	0.34	0.00145	2.46E-06	69	LD50-mouse	10000	0.0069	87.12	2.53	10.36	3.57E-04
Toluene	0	0.06	20	0.16308	4.64E-05	4.9	NOAEL-red fox	1	4.9	0.00	38.33	61.67	9.46E-06
Xylene (total)	0	0.057	1.9	0.01472	1.95E-05	0.39	NOAEL-red fox	1	0.39	0.00	86.74	13.26	4.99E-05
Zinc	0	0.02	0.6	0.00163	6.21E-06	68.88	NOAEL-red fox	1	68.88	0.00	95.39	4.61	9.02E-08

Red Fox Constants:		
Food Ingestion Rate (FI):	kg/day	0.268
Soil Ingestion Fraction (S):	unitless	0.028
Water Ingestion Rate (WI):	L/day	0.44
Food Ingestion Fraction (F):	unitless	0.972
Body Weight (BW):	kg	5.25
Home Range:	acres	1771
Site Area:	acres	6.26
Home Range Fraction (HR):	unitless	0.003535

a = no toxicity data available

EQ red fox = red fox intake/toxicity benchmark

Red fox intake = (HR/BW) x [(Conc in MV x FI x F) + (Conc in soil x FI x S) + (Conc in water x WI)]

Conc in MV = BAF x Meadow vole intake

Table K-28
Million Gallon Hill
Ecological Quotients for Terrestrial Invertebrates

Chemical	Conc in Soil mg/kg	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
2-Methylnaphthalene	0.031134				#DIV/0!	#DIV/0!
4,4'-DDD	0.05392				#DIV/0!	#DIV/0!
4,4'-DDE	0.014993				#DIV/0!	#DIV/0!
4,4'-DDT	0.139965				#DIV/0!	#DIV/0!
4-Methyl-2-Pentanone(MIBK)	0.001396				#DIV/0!	#DIV/0!
Acenaphthene	0.013519				#DIV/0!	#DIV/0!
alpha-BHC	0.001298				#DIV/0!	#DIV/0!
Anthracene	0.048964				#DIV/0!	#DIV/0!
Benz(a)anthracene	0.146901				#DIV/0!	#DIV/0!
Benzo(a)pyrene	0.342895	1	LC50-sandworm	10	0.1	3.42895
Benzo(b)fluoranthene	3.702475				#DIV/0!	#DIV/0!
Benzo(g,h,i)perylene	0.186899				#DIV/0!	#DIV/0!
Benzo(k)fluoranthene	0.510534				#DIV/0!	#DIV/0!
beta-BHC	0.002897	0.1	EC50-daphnia	10	0.01	0.28971
bis(2-Ethylhexyl)phthalate	0.131904				#DIV/0!	#DIV/0!
Chrysene	0.382				#DIV/0!	#DIV/0!
Dibenzofuran	0.013336				#DIV/0!	#DIV/0!
Dibutyl phthalate	0.028161				#DIV/0!	#DIV/0!
Dieldrin	0.001503				#DIV/0!	#DIV/0!
Endosulfan I	0.001954				#DIV/0!	#DIV/0!
Endosulfan sulfate	0.007142				#DIV/0!	#DIV/0!
Endrin aldehyde	0.001487				#DIV/0!	#DIV/0!
Fluoranthene	0.54421				#DIV/0!	#DIV/0!
Fluorene	0.017027	173	LC50-earthworm	10	17.3	0.000984
gamma-BHC	0.001858	0.008	LC50-insect	10	0.0008	2.321875
Heptachlor	0.001701				#DIV/0!	#DIV/0!
Indeno(1,2,3-cd)pyrene	0.171585				#DIV/0!	#DIV/0!
Lead	1306.965				#DIV/0!	#DIV/0!
Methoxychlor	7.31E-05				#DIV/0!	#DIV/0!
Methylene chloride	0.03061	224	LC50-daphnia	10	22.4	0.001367
Naphthalene	0.022365	3.8	LC50-sandworm	10	0.38	0.058855
Phenanthrene	0.163907	6	LC50-sandworm	10	0.6	0.273178
Pyrene	0.424412				#DIV/0!	#DIV/0!

a = no toxicity data available
EQ invertebrate = Concentration in soil/toxicity benchmark

Table K-29
Million Gallon Hill
Ecological Quotients for the Robin

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	Invert Uptake Factor	Conc in Invert mg/kg	Robin Intake mg/kg	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Invert	Total EQ
1,2-Dichloroethane	0	0.00042	2	0	2.86E-05	725	LD50-rat	10000	0.0725	0.00	100.00	0.00	3.95E-04
2-Methylnaphthalene	0.031134	0.07	0.342	0.010648	0.006098	1630	LD50-rat	10000	0.163	5.51	78.27	16.22	3.74E-02
2-Methylphenol (o-cresol)	0	0.022	17.78	0	0.0015	606	NOAEL-vole	10	60.6	0.00	100.00	0.00	2.48E-05
4,4'-DDD	0.05392	0.00025	5	0.269599	0.025649	0.00099	NOAEL-robin	1	0.00099	2.27	0.07	97.67	#######
4,4'-DDE	0.014993	0.000023	5	0.074964	0.007129	0.00099	NOAEL-robin	1	0.00099	2.27	0.02	97.71	#######
4,4'-DDT	0.139965	0	5	0.699823	0.066534	0.00099	NOAEL-robin	1	0.00099	2.27	0.00	97.73	#######
4-Methyl-2-Pentanone(MIBK)	0.001396	0	2.1	0.002932	0.000288	100	LD50-blackbird	10000	0.01	5.24	0.00	94.76	2.88E-02
4-Methylphenol (p-cresol)	0	0.09	13.5	0	0.006136	450	LOAEL-rat	100	4.5	0.00	100.00	0.00	1.36E-03
Acenaphthene	0.013519	0	0.34	0.004597	0.000573	8	LD50-rat	10000	0.0008	25.45	0.00	74.55	7.16E-01
alpha-BHC	0.001298	0	4.2	0.005452	0.000521	0.702	NOAEL-robin	1	0.702	2.69	0.00	97.31	7.42E-04
Anthracene	0.048964	0	a	a	a	a	a	a	a	a	a	a	a
Antimony	0	0.11	0.15	0	0.0075	300	LOAEL-rat	100	3	0.00	100.00	0.00	2.50E-03
Arsenic	0	0.016	9	0	0.001091	47.6	LD50-quail	10000	0.00476	0.00	100.00	0.00	2.29E-01
Barium	0	0.4	120	0	0.027273	10.77	NOAEL-vole	10	1.077	0.00	100.00	0.00	2.53E-02
Benz(a)anthracene	0.146901	0	0.125	0.018363	0.003291	180	dose-rat	10000	0.018	48.15	0.00	51.85	1.83E-01
Benzene	0	0.076	24	0	0.005182	930	LD50-rat	10000	0.093	0.00	100.00	0.00	5.57E-02
Benzo(a)pyrene	0.342895	0	0.342	0.11727	0.014594	0.881	NOAEL-vole	10	0.0881	25.34	0.00	74.66	1.66E-01
Benzo(b)fluoranthene	3.702475	0	a	a	a	a	a	a	a	a	a	a	a
Benzo(g,h,i)perylene	0.186899	0	a	a	a	a	a	a	a	a	a	a	a
Benzo(k)fluoranthene	0.510534	0	a	a	a	a	a	a	a	a	a	a	a
Benzoic acid	0	0.068	21	0	0.004636	1940	LD50-rat	10000	0.194	0.00	100.00	0.00	2.39E-02
Benzyl alcohol	0	0.0075	4	0	0.000511	1230	LD50-rat	10000	0.123	0.00	100.00	0.00	4.16E-03
beta-BHC	0.002897	0.00003	4.2	0.012168	0.001164	0.702	NOAEL-robin	1	0.702	2.68	0.18	97.14	1.66E-03
bis(2-Ethylhexyl)phthalate	0.131904	0	57	7.518545	0.700018	1.39	NOAEL-robin	1	1.39	0.20	0.00	99.80	5.04E-01
Chrysene	0.382	0	0.07	0.02674	0.006604	99	dose-rodent	10000	0.0099	62.38	0.00	37.62	6.67E-01
Cobalt	0	0.016	40	0	0.001091	5.7	LOAEL-mouse	100	0.057	0.00	100.00	0.00	1.91E-02
delta-BHC	0	0.000031	4.2	0	2.11E-06	0.702	NOAEL-robin	1	0.702	0.00	100.00	0.00	3.01E-06
Dibenzofuran	0.013336	0	5	0.066682	0.00634	0.015	LD50-bobwhite	3000	0.000005	2.27	0.00	97.73	#######
Dibutyl phthalate	0.028161	0	57	1.605154	0.149449	10	dose-dove	3000	0.00333333	0.20	0.00	99.80	#######
Dieldrin	0.001503	0	8	0.012026	0.001134	0.139	NOAEL-robin	1	0.139	1.43	0.00	98.57	8.16E-03
Endosulfan I	0.001954	0	59	0.115292	0.010734	17.2	NOAEL-robin	1	17.2	0.20	0.00	99.80	6.24E-04
Endosulfan sulfate	0.007142	0	59	0.421349	0.039227	17.2	NOAEL-robin	1	17.2	0.20	0.00	99.80	2.28E-03
Endrin aldehyde	0.001487	0	8	0.011899	0.001122	0.73	NOAEL-robin	1	0.73	1.43	0.00	98.57	1.54E-03
Ethyl benzene	0	0.003	37.5	0	0.000205	3500	LD50-rat	10000	0.35	0.00	100.00	0.00	5.84E-04
Fluoranthene	0.54421	0.00018	0.08	0.043537	0.009927	2000	LD50-rat	10000	0.2	59.13	0.12	40.75	4.96E-02
Fluorene	0.017027	0.0034	a	a	a	a	a	a	a	a	a	a	a
gamma-BHC	0.001858	0	4.2	0.007802	0.000745	4.66	NOAEL-robin	1	4.66	2.69	0.00	97.31	1.60E-04
Heptachlor	0.001701	0	10	0.017009	0.001599	92	LD50-bobwhite	3000	0.03066667	1.15	0.00	98.85	5.21E-02

Table K-29
Million Gallon Hill
Ecological Quotients for the Robin

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	Invert Uptake Factor	Conc in Invert mg/kg	Robin Intake mg/kg	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Invert	Total EQ
Heptachlor epoxide	0	0.00043	10	0	2.93E-05	92	LD50-bobwhite	3000	0.03066667	0.00	100.00	0.00	9.56E-04
Indeno(1,2,3-cd)pyrene	0.171585	0	a	a	a	a	a	a	a	a	a	a	a
Lead	1306.965	0	0.42	548.9252	65.09966	500	dose-quail	100	5	21.65	0.00	78.35	#######
Manganese	0	6	12	0	0.409091	174.45	NOAEL-vole	10	17.445	0.00	100.00	0.00	2.35E-02
Methoxychlor	7.31E-05	0	113	0.00826	0.000768	2000	LD50-grouse	100	20	0.10	0.00	99.90	3.84E-05
Methylene chloride	0.03061	0	2.3	0.070403	0.006872	11.6	NOAEL-vole	10	1.16	4.80	0.00	95.20	5.92E-03
Naphthalene	0.022365	0.049	0.34	0.007604	0.004289	4000	dose-mallard	10000	0.4	5.62	77.90	16.47	1.07E-02
Phenanthrene	0.163907	0.0013	0.12	0.019669	0.003684	4000	dose-mallard	10000	0.4	47.98	2.41	49.61	9.21E-03
Pyrene	0.424412	0.00021	a	a	a	a	a	a	a	a	a	a	a
Toluene	0	0.06	20	0	0.004091	22.9	NOAEL-vole	10	2.29	0.00	100.00	0.00	1.79E-03
Xylene (total)	0	0.057	1.9	0	0.003886	1.82	NOAEL-vole	10	0.182	0.00	100.00	0.00	2.14E-02
Zinc	0	0.02	0.6	0	0.001364	317.19	NOAEL-vole	10	31.719	0.00	100.00	0.00	4.30E-05

Robin constants:

Food Ingestion Rate (FI):	kg/day	0.01597
Soil Ingestion Fraction (S):	unitless	0.104
Water Ingestion Rate (WI):	L/day	0.0105
Food Ingestion Fraction (F):	unitless	0.896
Body Weight (BW):	kg	0.077
Home Range:	acres	2
Site Area:	acres	6.26
Home Range Fraction (HR):	unitless	1
Time on Site	months	6

a = no toxicity data available

EQ robin = robin intake/toxicity benchmark

Robin intake = (HR/BW) x 0.5 [(Conc in invert x FI x F) + (Conc in soil x FI x S) + (Conc in water x WI)]

Conc in invert = BAF x Conc in soil

Table K-30
Million Gallon Hill
Ecological Quotients for the Kestrel

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	Robin BAF	Conc in Robin mg/kg	Kestrel Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Robin	Total EQ
1,2-Dichloroethane	0	0.00042	2	5.73E-05	3.369E-07	725	LD50-rat	10000	0.0725	0.00	91.23	8.77	4.65E-06
2-Methylnaphthalene	0.031134	0.07	0.342	0.002085	5.408E-05	1630	LD50-rat	10000	0.163	3.30	94.71	1.99	3.32E-04
2-Methylphenol (o-cresol)	0	0.022	17.78	0.02667	2.985E-05	606	NOAEL-vole	10	60.6	0.00	53.93	46.07	4.93E-07
4,4'-DDD	0.05392	0.00025	5	0.128243	6.939E-05	0.00041	NOAEl-hawk	1	0.00041	4.45	0.26	95.28	1.69E-01
4,4'-DDE	0.014993	0.000023	5	0.035643	1.925E-05	0.00041	NOAEl-hawk	1	0.00041	4.46	0.09	95.45	4.70E-02
4,4'-DDT	0.139965	0	5	0.332672	0.0001795	0.00041	NOAEl-hawk	1	0.00041	4.47	0.00	95.53	4.38E-01
4-Methyl-2-Pentanone(MIBK)	0.001396	0	2.1	0.000604	3.913E-07	100	LD50-blackbird	10000	0.01	20.44	0.00	79.56	3.91E-05
4-Methylphenol (p-cresol)	0	0.09	13.5	0.082841	0.0001086	450	LOAEL-rat	100	4.5	0.00	60.66	39.34	2.41E-05
Acenaphthene	0.013519	0	0.34	0.000195	8.749E-07	8	LD50-rat	10000	0.0008	88.52	0.00	11.48	1.09E-03
alpha-BHC	0.001298	0	4.2	0.002186	1.202E-06	0.289	NOAEL-hawk	1	0.289	6.19	0.00	93.81	4.16E-06
Anthracene	0.048964	0	a	a	a	a	a	a	a	a	a	a	a
Antimony	0	0.11	0.15	0.001125	8.108E-05	300	LOAEL-rat	100	3	0.00	99.28	0.72	2.70E-05
Arsenic	0	0.016	9	0.009818	1.677E-05	47.6	LD50-quail	10000	0.00476	0.00	69.82	30.18	3.52E-03
Barium	0	0.4	120	3.272727	0.0019801	10.77	NOAEL-vole	10	1.077	0.00	14.78	85.22	1.84E-03
Benz(a)anthracene	0.146901	0	0.125	0.000411	8.628E-06	180	dose-rat	10000	0.018	97.54	0.00	2.46	4.79E-04
Benzene	0	0.076	24	0.124364	0.0001197	5.04	NOAEL-fox	10	0.504	0.00	46.45	53.55	2.38E-04
Benzo(a)pyrene	0.342895	0	0.342	0.004991	2.222E-05	0.191	NOAEL-fox	10	0.0191	88.42	0.00	11.58	1.16E-03
Benzo(b)fluoranthene	3.702475	0	a	a	a	a	a	a	a	a	a	a	a
Benzo(g,h,i)perylene	0.186899	0	a	a	a	a	a	a	a	a	a	a	a
Benzo(k)fluoranthene	0.510534	0	a	a	a	a	a	a	a	a	a	a	a
Benzoic acid	0	0.068	21	0.097364	9.996E-05	1940	LD50-rat	10000	0.194	0.00	49.78	50.22	5.15E-04
Benzyl alcohol	0	0.0075	4	0.002045	6.543E-06	1230	LD50-rat	10000	0.123	0.00	83.88	16.12	5.32E-05
beta-BHC	0.002897	0.00003	4.2	0.004888	2.708E-06	0.289	NOAEL-hawk	1	0.289	6.13	0.81	93.06	9.37E-06
bis(2-Ethylhexyl)phthalate	0.131904	0	57	39.90105	0.0205807	0.78	NOAEL-hawk	1	0.78	0.04	0.00	99.96	2.64E-02
Chrysene	0.382	0	0.07	0.000462	2.212E-05	99	dose-rodent	10000	0.0099	98.92	0.00	1.08	2.23E-03
Cobalt	0	0.016	40	0.043636	3.421E-05	5.7	LOAEL-mouse	100	0.057	0.00	34.23	65.77	6.00E-04
delta-BHC	0	0.000031	4.2	8.88E-06	2.726E-08	0.289	NOAEL-hawk	1	0.289	0.00	83.21	16.79	9.43E-08
Dibenzofuran	0.013336	0	5	0.031698	1.711E-05	5.7	LOAEL-mouse	100	0.057	4.47	0.00	95.53	3.00E-04
Dibutyl phthalate	0.028161	0	57	8.52E+00	4.39E-03	0.079	NOAEL-hawk	1	0.079	0.04	0.00	99.96	5.56E-02
Dieldrin	0.001503	0	8	9.07E-03	4.76E-06	0.058	NOAEL-hawk	1	0.058	1.81	0.00	98.19	8.21E-05
Endosulfan I	0.001954	0	59	6.33E-01	3.27E-04	7.1	NOAEL-hawk	1	7.1	0.03	0.00	99.97	4.60E-05
Endosulfan sulfate	0.007142	0	59	2.31E+00	1.19E-03	7.1	NOAEL-hawk	1	7.1	0.03	0.00	99.97	1.68E-04
Endrin aldehyde	0.001487	0	8	8.97E-03	4.71E-06	0.302	NOAEL-hawk	1	0.302	1.81	0.00	98.19	1.56E-05
Ethyl benzene	0	0.003	37.5	7.67E-03	6.15E-06	3500	LD50-rat	10000	0.35	0.00	35.70	64.30	1.76E-05
Fluoranthene	0.54421	0.00018	0.08	7.94E-04	3.17E-05	2000	LD50-rat	10000	0.2	98.29	0.42	1.29	1.59E-04
Fluorene	0.017027	0.0034	a	a	a	a	a	a	a	a	a	a	a
gamma-BHC	0.001858	0	4.2	3.13E-03	1.72E-06	1.92	NOAEL-hawk	1	1.92	6.19	0.00	93.81	8.96E-07
Heptachlor	0.001701	0	10	1.60E-02	8.34E-06	1.5	dose-kestrel	10	0.15	1.17	0.00	98.83	5.56E-05
Heptachlor epoxide	0	0.00043	10	2.93E-04	4.66E-07	1.5	dose-kestrel	10	0.15	0.00	67.55	32.45	3.11E-06

Table K-30
Million Gallon Hill
Ecological Quotients for the Kestrel

Chemical	Conc in Soil mg/kg	Conc in Water mg/L	Robin BAF	Conc in Robin mg/kg	Kestrel Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Soil	% EQ Water	% EQ Robin	Total EQ
Indeno(1,2,3-cd)pyrene	0.171585	0	a	a	a	a	a	a	a	a	a	a	a
Lead	1306.965	0	0.42	2.73E+01	8.90E-02	125	dose-kestrel	10	12.5	84.16	0.00	15.84	7.12E-03
Manganese	0	6	12	4.91E+00	6.92E-03	37.88	NOAEL-fox	10	3.788	0.00	63.43	36.57	1.83E-03
Methoxychlor	7.31E-05	0	113	8.68E-02	4.48E-05	2000	LD50-grouse	10000	0.2	0.01	0.00	99.99	2.24E-04
Methylene chloride	0.03061	0	2.3	1.58E-02	9.90E-06	2.51	NOAEL-fox	10	0.251	17.71	0.00	82.29	3.95E-05
Naphthalene	0.022365	0.049	0.34	1.46E-03	3.79E-05	4000	dose-mallard	10000	0.4	3.38	94.63	1.98	9.47E-05
Phenanthrene	0.163907	0.0013	0.12	4.42E-04	1.06E-05	4000	dose-mallard	10000	0.4	88.84	9.00	2.16	2.64E-05
Pyrene	0.424412	0.00021	a	a	a	a	a	a	a	a	a	a	a
Toluene	0	0.06	20	8.18E-02	8.61E-05	4.9	NOAEL-fox	10	0.49	0.00	51.00	49.00	1.76E-04
Xylene (total)	0	0.057	1.9	7.38E-03	4.55E-05	0.394	NOAEL-fox	10	0.0394	0.00	91.64	8.36	1.16E-03
Zinc	0	0.02	0.6	8.18E-04	1.51E-05	68.88	NOAEL-fox	10	6.888	0.00	97.20	2.80	2.19E-06

Kestrel constants:

Food Ingestion Rate (FI):	kg/day	0.01096
Soil Ingestion Fraction (S):	unitless	0.1
Water Ingestion Rate (WI):	L/day	0.014
Food Ingestion Fraction (F):	unitless	0.9
Body Weight (BW):	kg	0.12
Home Range:	acres	499
Site Area:	acres	6.26
Home Range Fraction (HR):	unitless	0.012545
Time on site:	months	6

a = no toxicity data available
EQ kestrel = kestrel intake/ toxicity benchmark
Kestrel intake = (HR/BW) x 0.5 x [(Conc in sparrow x FI x F) + (Conc in soil x FI x S) + (Conc in water x WI)]
Conc in sparrow = BAF x sparrow intake

Table K-31
Million Gallon Hill/Waste Accumulation Area
Ecological Quotients for Aquatic Invertebrates at the Drainage Ditches

Chemical	Conc in Sediment mg/kg	Conc in Water mg/L	Toxicity Data - Sed mg/kg	Reference	Uncert Factor	Toxicity Benchmark Sediment	Toxicity Data - Wat mg/L	Reference	Uncert Factor	Toxicity Benchmark Water	Sediment Total EQ	Water Total EQ
1,2-Dichloroethane	0	0.00042	b	b	b	b	202	LC50-guppy	10000	0.0202	a	2.08E-02
2-Hexanone	1.40E+00	0	a	a	a	a	b	b	b	b	a	b
2-Methylnaphthalene	2.40E+01	0.07	38.6384	SQC	1	38.6384	1.1	LC50-shrimp	10000	0.00011	6.21E-01	6.36E+02
2-Methylphenol(o-cresol)	0	0.022	b	b	b	b	0.15	AWQC	1	0.15	a	1.47E-01
4,4'-DDD	5.70E-02	0.00025	0.0077	SQC	1	0.0077	0.000001	AWQC	1	0.000001	7.40E+00	2.50E+02
4,4'-DDE	1.70E-02	0.000023	0.044	SQC	1	0.044	0.000001	AWQC	1	0.000001	3.86E-01	2.30E+01
4,4'-DDT	1.80E-02	0	0.00243	SQC	1	0.00243	b	b	b	b	7.41E+00	b
4-Methyl-2 Pentanone (MIBK)	5.36E-04	0	a	a	a	a	b	b	b	b	a	b
4-Methylphenol(p-cresol)	0	0.09	b	b	b	b	0.15	AWQC	1	0.15	a	6.00E-01
Acenaphthene	5.09E-03	0	23.92	SQC	1	23.92	b	b	b	b	2.13E-04	b
Acetone	2.31E-03	0	a	a	a	a	b	b	b	b	a	b
alpha-BHC	1.60E-02	0	0.00228	SQC	1	0.00228	b	b	b	b	7.02E+00	b
Aluminum	1.10E+04	0	a	a	a	a	b	b	b	b	a	b
Anthracene	6.65E-03	0	a	a	a	a	b	b	b	b	a	a
Antimony	0	0.11	b	b	b	b	0.03	AWQC	1	0.03	a	3.67E+00
Arsenic	1.10E+01	0.016	8.2	ER-L	1	8.2	0.19	AWQC	1	0.19	1.34E+00	8.42E-02
Barium	2.00E+02	0.4	a	a	a	a	68	LC50-daphnia	100	0.68	a	5.88E-01
Benz(a)anthracene	3.86E-02	0	a	a	a	a	b	b	b	b	a	b
Benzene	4.47E-04	0.076	a	a	a	a	5.3	AWQC	1	5.3	a	1.43E-02
Benzo(a)pyrene	7.90E-03	0	a	a	a	a	b	b	b	b	a	b
Benzo(b)fluoranthene	3.27E-02	0	a	a	a	a	b	b	b	b	a	b
Benzo(g,h,i)perylene	2.85E-02	0	a	a	a	a	b	b	b	b	a	b
Benzo(k)fluoranthene	1.28E-02	0	a	a	a	a	b	b	b	b	a	b
Benzoic acid	0	0.068	b	b	b	b	a	a	a	a	a	a
Benzyl alcohol	0	0.0075	b	b	b	b	15	LC50-fish	10000	0.0015	a	5.00E+00
Beryllium	2.80E-01	0	a	a	a	a	b	b	b	b	a	b
beta-BHC	0	0.00003	b	b	b	b	0.1	EC50-daphnia	100	0.001	a	3.00E-02
bis(2-Ethylhexyl)phthalate	1.20E-01	0	259.6	SQC	1	259.6	540	LC50-trout	1000	0.54	4.64E-04	b
Chromium	2.40E+01	0	81	ER-L	1	81	b	b	b	b	2.96E-01	b
Chrysene	1.85E-02	0	a	a	a	a	b	b	b	b	a	b
Cobalt	1.30E+01	0.016	a	a	a	a	100	EC-minnow	10000	0.01	a	1.60E+00
Copper	3.10E+01	0	34	ER-L	1	34	b	b	b	b	9.12E-01	b
delta-BHC	0	0.000031	b	b	b	b	0.00008	AWQC	1	0.00008	a	3.88E-01
Dibenzofuran	1.15E-02	0	a	a	a	a	b	b	b	b	a	b
Dibutyl phthalate	2.64E-02	0	a	a	a	a	b	b	b	b	a	b
Dieldrin	8.80E-03	0	0.0000323	SQC	1	0.0000323	b	b	b	b	2.72E+02	b
Endosulfan II	3.10E-02	0	0.00326088	SQC	1	0.00326088	b	b	b	b	9.51E+00	b
Endrin aldehyde	2.30E-04	0	0.00069902	SQC	1	0.00069902	b	b	b	b	3.29E-01	b

Table K-31
Million Gallon Hill/Waste Accumulation Area
Ecological Quotients for Aquatic Invertebrates at the Drainage Ditches

Chemical	Conc in Sediment mg/kg	Conc in Water mg/L	Toxicity Data - Sed mg/kg	Reference	Uncert Factor	Toxicity Benchmark Sediment	Toxicity Data - Wat mg/L	Reference	Uncert Factor	Toxicity Benchmark Water	Sediment Total EQ	Water Total EQ
Ethylbenzene	3.50E-01	0.003	a	a	a	a	275	LC50-shrimp	10000	0.0275	a	1.09E-01
Fluoranthene	9.01E-02	0.00018	a	a	a	a	3.98	AWQC	1	3.98	a	4.52E-05
Fluorene	2.60E+00	0.0034	a	a	a	a	1	LC50-shrimp	10000	0.0001	a	3.40E+01
gamma-BHC	1.50E-02	0	0.000648	SQC	1	0.000648	b	b	b	b	2.31E+01	b
Heptachlor	1.60E-03	0	0.00456	SQC	1	0.00456	b	b	b	b	3.51E-01	b
Heptachlor epoxide	1.20E-03	0.00043	0.0000836	SQC	1	0.0000836	0.0000038	AWQC	1	0.0000038	1.44E+01	1.13E+02
Indeno (1,2,3-cd)pyrene	2.20E-02	0	a	a	a	a	b	b	b	b	a	b
Lead	1.20E+01	0	46.7	ER-L	1	46.7	b	b	b	b	2.57E-01	b
Manganese	4.40E+02	6	a	a	a	a	130	LC50-fish	10000	0.013	a	4.62E+02
Mercury	7.40E-02	0	0.15	ER-L	1	0.15	b	b	b	b	4.93E-01	b
Methoxychlor	7.80E-05	0	0.0119631	SQC	1	0.0119631	b	b	b	b	6.52E-03	b
Methylene chloride	3.08E-03	0	a	a	a	a	b	b	b	b	a	b
Molybdenum	5.00E+00	0	a	a	a	a	b	b	b	b	a	b
Naphthalene	1.00E+01	0.049	1088.1	SQC	1	1088.1	0.62	AWQC	1	0.62	9.19E-03	7.90E-02
Nickel	3.00E+01	0	20.9	ER-L	1	20.9	b	b	b	b	1.44E+00	b
Phenanthrene	4.70E-02	0.0013	a	a	a	a	0.063	AWQC	1	0.063	a	2.06E-02
Phenol	0	0.053	b	b	b	b	2.56	AWQC	1	2.56	a	2.07E-02
Pyrene	1.13E-01	0.00021	a	a	a	a	a	a	a	a	a	a
Toluene	1.00E+00	0.06	a	a	a	a	17.5	AWQC	1	17.5	a	3.43E-03
Vanadium	3.80E+01	0	a	a	a	a	b	b	b	b	a	b
Xylene (total)	5.80E+00	0.057	a	a	a	a	13	LC50-fish	10000	0.0013	a	4.38E+01
Zinc	8.60E+01	0.02	150	ER-L	1	150	0.11	AWQC	1	0.11	5.73E-01	1.82E-01

a = No toxicity data available
b = Sediment criteria not applicable
EQ for invertebrate from exposure to sediment = Conc in sediment/sediment toxicity benchmark
EQ for invertebrate from exposure to surface water = Conc in water / water toxicity benchmark

Table K-32
Million Gallon Hill/Waste Accumulation Area
Ecological Quotients for the Spotted Sandpiper at the Drainage Ditches

Chemical	Conc in Sediment mg/kg	Conc in Water mg/L	Invert Uptake Factor	Conc Invert mg/kg	SSP Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Sediment	% EQ Water	% EQ Invert	Total EQ
1,2-Dichloroethane	0	0.00042	2	0.00084	0.0025604	46.81	NOAEL-robin	1	46.81	0	98.21144	1.788562	5.47E-05
2-Hexanone	1.40E+00	0	7	9.8	0.5510286	200	LOAEL-hen	100	2	3.040541	0	96.95946	2.76E-01
2-Methylnaphthalene	2.40E+01	0.07	1000	24070	1312.9495	1630	LD50-rat	10000	0.163	0.021876	0.031921	99.9462	8.05E+03
2-Methylphenol(o-cresol)	0	0.022	18	0.396	0.1533082	606	NOAEL-vole	10	60.6	0	85.91788	14.08212	2.53E-03
4,4'-DDD	5.70E-02	0.00025	12000	687	37.455899	0.00032	NOAEL-heron	10	0.000032	0.001821	0.003996	99.99418	1.17E+06
4,4'-DDE	1.70E-02	0.000023	12000	204.276	11.137017	0.00032	NOAEL-heron	10	0.000032	0.001827	0.001236	99.99694	3.48E+05
4,4'-DDT	1.80E-02	0	12000	216	11.776057	0.00032	NOAEL-heron	10	0.000032	0.001829	0	99.99817	3.68E+05
4-Methyl-2 Pentanone (MIBK)	5.36E-04	0	2.1	0.001126	6.782E-05	100	LD50-blackbird	10000	0.01	9.463722	0	90.53628	6.78E-03
4-Methylphenol(p-cresol)	0	0.09	18	1.62	0.6271699	606	NOAEL-vole	10	60.6	0	85.91788	14.08212	1.03E-02
Acenaphthene	5.09E-03	0	2.6	0.013228	0.0007821	2000	dose-rat	10000	0.2	7.785467	0	92.21453	3.91E-03
Acetone	2.31E-03	0	0.69	0.001593	0.0001145	40000	LD50-pheasant	10000	4	24.13516	0	75.86484	2.86E-05
alpha-BHC	1.60E-02	0	1100	17.6	0.9597045	0.226	NOAEL-heron	10	0.0226	0.019952	0	99.98005	4.25E+01
Aluminum	1.10E+04	0	0.004	44	134.03929	540	LOAEL-rat	100	5.4	98.21039	0	1.789612	2.48E+01
Anthracene	6.65E-03	0	200	1.329912	0.0725834	a	a	a	a	a	a	a	a
Antimony	0	0.11	0.15	0.0165	0.6594953	2	LOAEL-rat	100	0.02	0	99.8636	0.136399	3.30E+01
Arsenic	1.10E+01	0.016	9	99.144	5.6325478	0.111	NOAEL-vole	10	0.0111	2.33714	1.700753	95.96211	5.07E+02
Barium	2.00E+02	0.4	120	24048	1315.8321	10.77	NOAEL-vole	10	1.077	0.181897	0.182006	99.6361	1.22E+03
Benz(a)anthracene	3.86E-02	0	10109	390.319	21.27979	a	a	a	a	a	a	a	a
Benzene	4.47E-04	0.076	4.27	0.326428	0.4728313	23.23	NOAEL-vole	10	2.323	0.001131	96.23513	3.763741	2.04E-01
Benzo(a)pyrene	7.90E-03	0	242	1.911672	0.1043147	0.881	NOAEL-vole	10	0.0881	0.090625	0	99.90937	1.18E+00
Benzo(b)fluoranthene	3.27E-02	0	24431	798.1563	43.514105	a	a	a	a	a	a	a	a
Benzo(g,h,i)perylene	2.85E-02	0	54836	1561.81	85.146785	a	a	a	a	a	a	a	a
Benzo(k)fluoranthene	1.28E-02	0	24400	311.6306	16.989566	a	a	a	a	a	a	a	a
Benzoic acid	0	0.068	21	1.428	0.4849833	1940	LD50-mouse	10000	0.194	0	83.94761	16.05239	2.50E+00
Benzyl alcohol	0	0.0075	4	0.03	0.0465398	1230	LD50-rat	10000	0.123	0	96.48573	3.51427	3.78E-01
Beryllium	2.80E-01	0	19	5.32	0.2933855	18.3	LD50-rat	10000	0.00183	1.142132	0	98.85787	1.60E+02
beta-BHC	0	0.00003	1460	0.0438	0.0025675	0.226	NOAEL-heron	10	0.0226	0	6.995805	93.00419	1.14E-01
bis(2-Ethylhexyl)phthalate	1.20E-01	0	57	6.860671	0.375469	1.39	NOAEL-robin	10	0.139	0.383632	0	99.61637	2.70E+00
Chromium	2.40E+01	0	86	2064	112.81193	10	dose-duck	10000	0.001	0.254597	0	99.7454	1.13E+05
Chrysene	1.85E-02	0	10816	199.9027	10.898473	a	a	a	a	a	a	a	a
Cobalt	1.30E+01	0.016	40	520.64	28.635512	5.7	LOAEL-mouse	100	0.057	0.543294	0.334535	99.12217	5.02E+02
Copper	3.10E+01	0	10	310	17.271501	425	LOAEL-mouse	100	4.25	2.147971	0	97.85203	4.06E+00
delta-BHC	0	0.000031	850	0.02635	0.0016221	0.226	NOAEL-heron	10	0.0226	0	11.44188	88.55812	7.18E-02
Dibenzofuran	1.15E-02	0	589	6.745562	0.3678902	0.015	LD50-bobwhite	10000	0.0000015	0.037255	0	99.96275	2.45E+05
Dibutyl phthalate	2.64E-02	0	57	1.503258	0.0822699	0.045	NOAEL-heron	10	0.0045	0.383632	0	99.61637	1.83E+01
Dieldrin	8.80E-03	0	2700	23.76	1.2954479	0.045	NOAEL-heron	10	0.0045	0.008129	0	99.99187	2.88E+02
Endosulfan II	3.10E-02	0	59	1.829	0.100084	17.22	NOAEL-robin	10	1.722	0.37	0.00	99.63	5.81E-02
Endrin aldehyde	2.30E-04	0	3.146	0.000724	4.22E-05	0.73	NOAEL-robin	100	0.0073	6.52	0.00	93.48	5.78E-03

Table K-32
Million Gallon Hill/Waste Accumulation Area
Ecological Quotients for the Spotted Sandpiper at the Drainage Ditches

Chemical	Conc in Sediment mg/kg	Conc in Water mg/L	Invert Uptake Factor	Conc Invert mg/kg	SSP Intake mg/kg-d	Toxicity Data mg/kg-d	Reference	Uncert Factor	Toxicity Benchmark	% EQ Sediment	% EQ Water	% EQ Invert	Total EQ
Ethylbenzene	3.50E-01	0.003	144	50.832	2.7933984	3500	LD50-rat	10000	0.35	0.15	0.64	99.21	7.98E+00
Fluoranthene	9.01E-02	0.00018	380	34.30223	1.8722376	2000	LD50-rat	10000	0.2	0.06	0.06	99.88	9.36E+00
Fluorene	2.60E+00	0.0034	5000	13017	709.70951	2000	LD50-rat	10000	0.2	0.00	0.00	99.99	3.55E+03
gamma-BHC	1.50E-02	0	319	4.785	0.2610471	4.66	NOAEL-robin	10	0.466	0.07	0.00	99.93	5.60E-01
Heptachlor	1.60E-03	0	20	0.032	0.0017637	92	LC50-quail	10000	0.0092	1.09	0.00	98.91	1.92E-01
Heptachlor epoxide	1.20E-03	0.00043	20	0.0326	0.0043662	92	LC50-quail	10000	0.0092	0.33	58.97	40.71	4.75E-01
Indeno (1,2,3-cd)pyrene	2.20E-02	0	54836	1204.534	65.668801	a	a	a	a	a	a	a	a
Lead	1.20E+01	0	42	504	27.620573	100	dose-gull	10000	0.01	0.52	0.00	99.48	2.76E+03
Manganese	4.40E+02	6	12	5352	332.96822	174.45	NOAEL-vole	10	17.445	1.58	10.79	87.63	1.91E+01
Mercury	7.40E-02	0	65	4.81	0.2631161	5	LOAEL-mouse	10000	0.0005	0.34	0.00	99.66	5.26E+02
Methoxychlor	7.80E-05	0	113	0.008814	0.0004815	2000	LD50-mallard	10000	0.2	0.19	0.00	99.81	2.41E-03
Methylene chloride	3.08E-03	0	2.3	0.007095	0.0004237	8.49	LD50-chicken	10000	0.000849	8.71	0.00	91.29	4.99E-01
Molybdenum	5.00E+00	0	4.8	24.0112	1.3689022	10	dose-rat	10000	0.001	4.37	0.00	95.63	1.37E+03
Naphthalene	1.00E+01	0.049	1000	10049	548.26229	40000	dose-mallard	10000	4	0.02	0.05	99.92	1.37E+02
Nickel	3.00E+01	0	100	3000	163.91238	700	dose-mallard	10000	0.07	0.22	0.00	99.78	2.34E+03
Phenanthrene	4.70E-02	0.0013	325	15.693	0.8638935	700	LD50-mouse	10000	0.07	0.07	0.90	99.03	1.23E+01
Phenol	0	0.053	20	1.06	0.3751123	980	dose-rat	10000	0.098	0.00	84.59	15.41	3.83E+00
Pyrene	1.13E-01	0.00021	69	7.791287	0.4273698	800	LD50-mouse	10000	0.08	0.32	0.29	99.39	5.34E+00
Toluene	1.00E+00	0.06	90	95.4	5.5721983	22.9	NOAEL-vole	10	2.29	0.21	6.45	93.34	2.43E+00
Vanadium	3.80E+01	0	1	38	2.526434	300	dose-hen	10000	0.03	18.00	0.00	82.00	8.42E+01
Xylene (total)	5.80E+00	0.057	80	468.56	25.955537	1.82	NOAEL-vole	10	0.182	0.27	1.31	98.42	1.43E+02
Zinc	8.60E+01	0.02	8	688.16	38.665895	317.19	NOAEL-vole	10	31.719	2.66	0.31	97.03	1.22E+00

Spotted Sandpiper Constants:

Food Ingestion Rate (FI):	kg/day	0.00744
Soil Ingestion Fraction (S):	unitless	0.18
Water Ingestion Rate (WI):	L/day	0.67
Food Ingestion Fraction (F):	unitless	0.82
Body Weight (BW):	kg	0.047
Home range:	acres	2.5
Site Area (WAA + MGH)	acres	7.07
Home Range Fraction (HR):	unitless	1
Time on site:	months	5

a = no toxicity data available
EQ = sandpipe intake/toxicty benchmark
Intake = (HR/BW) x 0.42 x [(Conc in invert x FI X F) + (Conc in water x FI) + (Conc in sediment x FI x S)]
Conc in invertebrate = [(Conc in sediment x uptake factor) + (Conc in water x uptake factor)]

Table K-33
JP4-Fillstands
Ecological Quotients for the Northern Pike from Discharged Groundwater

Chemical	Conc in Water mg/L	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
1,1-Dichloroethane	2.66E-10	202	LC50-guppy	6000	0.03366667	7.89E-09
1,2-Dichloroethane	4.08E-10	20	AWQC	1	20	2.04E-11
2-Methylnaphthalene	1.77E-07	2	LC50-minnow	10000	0.0002	8.83E-04
2-Methylphenol(o-cresol)	1.60E-44	0.15	AWQC	1	0.15	1.07E-43
4,4'-DDD	6.30E-10	0.000001	AWQC	1	0.000001	6.30E-04
4,4'-DDT	2.26E-10	0.000001	AWQC	1	0.000001	2.26E-04
4-Methylphenol(p-cresol)	1.25E-25	0.15	AWQC	1	0.15	8.33E-25
Aldrin	1.52E-10	0.0000019	AWQC	1	0.0000019	7.99E-05
alpha-BHC	6.97E-12	0.032	EC-guppy	10000	0.0000032	2.18E-06
Arsenic	1.09E-06	0.19	AWQC	1	0.19	5.76E-06
Barium	2.27E-05	68	LC50-daphnia	10000	0.0068	3.34E-03
Benzene	7.43E-08	5.3	AWQC	10	0.53	1.40E-07
Benzoic acid	8.48E-08	a	a	a	a	a
beta-BHC	9.34E-12	0.032	EC-guppy	10000	0.0000032	2.92E-06
bis(2-Ethylhexyl)phthalate	2.21E-09	540	LC50-trout	10000	0.054	4.09E-08
Bromochloromethane	5.08E-07	a	a	a	a	a
cis-1,2-Dichloroethene	3.16E-08	11.6	AWQC	1	11.6	2.73E-09
Endosulfan I	2.09E-67	0.0000056	AWQC	1	0.0000056	3.72E-62
Endrin aldehyde	2.59E-10	0.0000023	AWQC	1	0.0000023	1.13E-04
Ethylbenzene	7.08E-11	42.3	LC100-minnow	10000	0.00423	1.67E-08
gamma-BHC	3.49E-12	0.023	LC50-salmon	10000	0.0000023	1.52E-06
Heptachlor	4.89E-106	0.0000038	AWQC	1	0.0000038	1.29E-100
Heptachlor epoxide	4.50E-11	0.0000038	AWQC	1	0.0000038	1.19E-05
Lead	2.31E-07	0.0032	AWQC	1	0.0032	7.21E-05
Naphthalene	3.74E-09	0.62	AWQC	1	0.62	6.03E-09
Phenol	7.97E-81	2.56	AWQC	1	2.56	3.11E-81
Selenium	1.67E-07	0.005	AWQC	1	0.005	3.35E-05
Toluene	4.80E-28	17.5	AWQC	10	1.75	2.75E-28
Trichloroethene	1.91E-08	21.9	AWQC	1	21.9	8.71E-10
Xylene (total)	3.82E-07	13.5	LC50-trout	100	0.135	2.83E-06

a = no toxicity information available
EQ pike =concentration in water/toxicity benchmark
Concentration in water = modeled groundwater concentrations at the 5-foot range from shoreline (see Appendix C

Table K-34
JP4-Fillstands
Ecological Quotients for Aquatic Invertebrates at the Mudflats

Chemical	Conc in GW mg/L	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
1,1-Dichloroethane	1.31E-05	202	LC50-guppy	10000	0.0202	6.49E-04
1,2-Dichloroethane	2.01E-05	20	AWQC	1	20	1.01E-06
2-Methylnaphthalene	0.008715	1.1	LC50-shrimp	10000	0.00011	7.92E+01
2-Methylphenol(o-cresol)	7.92E-40	0.15	AWQC	1	0.15	5.28E-39
4,4'-DDD	3.11E-05	0.000001	AWQC	1	0.000001	3.11E+01
4,4'-DDT	1.12E-05	0.000001	AWQC	1	0.000001	1.12E+01
4-Methylphenol(p-cresol)	6.17E-21	0.15	AWQC	1	0.15	4.11E-20
Aldrin	7.5E-06	0.0000019	AWQC	1	0.0000019	3.95E+00
alpha-BHC	3.44E-07	0.1	EC50-daphnia	100	0.001	3.44E-04
Arsenic	0.054006	0.036	AWQC	1	0.036	1.50E+00
Barium	1.119796	68	LC50-daphnia	100	0.68	1.65E+00
Benzene	0.00367	5.3	AWQC	1	5.3	6.92E-04
Benzoic acid	0.004185	a	a	a	a	a
beta-BHC	4.61E-07	0.1	EC50-daphnia	100	0.001	4.61E-04
bis(2-Ethylhexyl)phthalate	0.000109	540	LC50-trout	1000	0.54	2.02E-04
Bromochloromethane	0.025083	a	a	a	a	a
cis-1,2-Dichloroethene	0.001561	11.6	AWQC-acute	10	1.16	1.35E-03
Endosulfan I	1.03E-62	0.0000056	AWQC	1	0.0000056	1.84E-57
Endrin aldehyde	1.28E-05	0.0000023	AWQC	1	0.0000023	5.56E+00
Ethylbenzene	3.49E-06	275	LC50-shrimp	10000	0.0275	1.27E-04
gamma-BHC	1.73E-07	0.46	LC48-daphnia	100	0.0046	3.75E-05
Heptachlor	2.4E-101	0.0000038	AWQC	1	0.0000038	6.36E-96
Heptachlor epoxide	2.22E-06	0.0000038	AWQC	1	0.0000038	5.85E-01
Lead	0.01139	0.0032	AWQC	1	0.0032	3.56E+00
Naphthalene	0.000185	0.62	AWQC	1	0.62	2.98E-04
Phenol	3.94E-76	2.56	AWQC	1	2.56	1.54E-76
Selenium	0.008267	0.005	AWQC	1	0.005	1.65E+00
Toluene	2.37E-23	17.5	AWQC	1	17.5	1.36E-24
Trichloroethene	0.000942	21.9	AWQC	1	21.9	4.30E-05
Xylene (total)	0.018866	13	LC50-fish	10000	0.0013	1.45E+01

a = no toxicity data available
EQ = Concentration in water/toxicity benchmark
Concentration in water = modeled groundwater concentrations discharging to the shoreline (see Appendix C)

Table K-35
JP4-Fillstands
Ecological Quotients for the Spotted Sandpiper at the Mudflats

Chemical	Conc in GW mg/L	Insect Uptake Factor	Conc in Invert mg/kg	SSP Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Water	% EQ Invert.	Total EQ
1,1-Dichloroethane	1.31E-05	6.6	8.65E-05	4.43E-05	725	LD50-rat	10000	0.0725	94.33095	5.669048	6.11E-04
1,2-Dichloroethane	2.01E-05	2	4.03E-05	6.53E-05	46.81	NOAEL-robin	1	46.81	98.21144	1.788562	1.39E-06
2-Methylnaphthalene	0.008715	1000	8.715213	2.81E-01	1630	LD50-rat	10000	0.163	9.895433	90.10457	1.72E+00
2-Methylphenol(o-cresol)	7.92E-40	18	1.42E-38	2.93E-39	606	NOAEL-vole	10	60.6	85.91788	14.08212	4.84E-41
4,4'-DDD	3.11E-05	12000	0.373089	1.09E-02	0.00032	NOAEL-heron	10	0.000032	0.906881	99.09312	3.41E+02
4,4'-DDT	1.12E-05	12000	0.134036	3.92E-03	0.00032	NOAEL-heron	10	0.000032	0.906881	99.09312	1.23E+02
4-Methylphenol(p-cresol)	6.17E-21	18	1.11E-19	2.29E-20	606	NOAEL-vole	10	60.6	85.91788	14.08212	3.77E-22
Aldrin	7.5E-06	3140	0.023545	7.07E-04	0.045	NOAEL-heron	10	0.0045	3.38	96.62	1.57E-01
alpha-BHC	3.44E-07	1100	0.000378	1.21E-05	0.226	NOAEL-heron	10	0.0226	9.08	90.92	5.34E-04
Arsenic	0.054006	9	0.486056	1.86E-01	0.111	NOAEL-vole	10	0.0111	92.43	7.57	1.68E+01
Barium	1.119796	120	134.3755	7.46E+00	10.77	NOAEL-vole	10	1.077	47.79	52.21	6.93E+00
Benzene	0.00367	4.27	0.015671	1.21E-02	23.23	NOAEL-vole	10	2.323	96.26	3.74	5.23E-03
Benzoic acid	0.004185	21	0.087882	1.59E-02	1940	LD50-mouse	10000	0.194	83.95	16.05	8.18E-02
beta-BHC	4.61E-07	1460	0.000673	2.10E-05	0.226	NOAEL-heron	10	0.0226	7.00	93.00	9.29E-04
bis(2-Ethylhexyl)phthalate	0.000109	57	0.006211	5.27E-04	1.39	NOAEL-robin	10	0.139	65.83	34.17	3.79E-03
Bromochloromethane	0.025083	a	a	a	a	a	a	a	a	a	a
cis-1,2-Dichloroethene	0.001561	23	0.03591	6.01E-03	39.8	NOAEL-vole	10	3.98	82.68	17.32	1.51E-03
Endosulfan I	1.03E-62	59	6.07E-61	5.04E-62	17.22	NOAEL-robin	10	1.722	65.05	34.95	2.93E-62
Endrin aldehyde	1.28E-05	121	0.001549	8.57E-05	0.73	NOAEL-robin	10	0.35	47.58	52.42	2.45E-04
Ethylbenzene	3.49E-06	144	0.000503	2.57E-05	3500	LD50-rat	10000	0.466	43.27	56.73	5.52E-05
gamma-BHC	1.73E-07	319	5.5E-05	2.15E-06	4.66	NOAEL-robin	10	0.466	25.61	74.39	4.61E-06
Heptachlor	2.4E-101	20	4.8E-100	9.09E-101	92	LC50-quail	10000	0.0092	84.59	15.41	9.88E-99
Heptachlor epoxide	2.22E-06	20	4.45E-05	8.37E-06	92	LC50-quail	10000	0.0092	84.59	15.41	9.10E-04
Lead	0.01139	42	0.478377	5.02E-02	100	dose-gull	10000	0.01	72.34	27.66	5.02E+00
Naphthalene	0.000185	1000	0.184544	5.94E-03	4000	dose-mallard	10000	0.4	9.90	90.10	1.49E-02
Phenol	3.94E-76	20	7.87E-75	1.48E-75	980	Dose-rat	10000	0.098	84.59	15.41	1.51E-74
Selenium	0.008267	10.5	0.086807	2.89E-02	0.066	Dose-mallard	10	0.0066	91.27	8.73	4.37E+00
Toluene	2.37E-23	90	2.13E-21	1.37E-22	22.9	NOAEL-vole	10	2.29	54.96	45.04	6.00E-23
Trichloroethene	0.000942	17	0.016018	3.47E-03	1000	LOAEL-mouse	100	10	86.60	13.40	3.47E-04
Xylene (total)	0.018866	80	1.509313	1.04E-01	1.82	NOAEL-vole	10	0.182	57.86	42.14	5.71E-01

Table K-35
JP4-Fillstands
Ecological Quotients for the Spotted Sandpiper at the Mudflats

Chemical	Conc in GW mg/L	Insect Uptake Factor	Conc in Invert mg/kg	SSP Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Water	% EQ Invert.	Total EQ

Spotted Sandpiper Constants:		
Body weight (BW):	kg	0.047
Water Intake (WI):	L/day	0.67
Food Ingestion rate (FI):	kg/day	0.00744
Soil Ingestion fraction (S):	unitless	0.18
Food Ingestion fraction (F):	unitless	0.82
Home Range:	acres	2.5
Time on site:	months	5
Home Range Fraction (HR):	unitless	0.532
Site Area:	acres	1.33

a = no toxicity data available

EQ = sandpiper intake/toxicity benchmark

Intake = (HR/BW) x 0.42 x ((Conc in Invert x FI x FF) + (Conc in water x WI))

Conc. in Water = modeled groundwater concentrations discharged to the mudflats (Appendix C)

Table K-36
Building 1845
Ecological Quotients for the Northern Pike from Discharged Groundwater

Chemical	Conc in Water mg/L	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity enchmar	Total EQ
1,1,2-Trichloroethane	4.87E-07	9.4	AWQC	1	9.4	5.19E-08
1,1-Dichloroethane	5.12E-08	202	LC50-guppy	6000	0.0336667	1.52E-06
1,1-Dichloroethene	1.38E-09	11.6	AWQC	1	11.6	1.19E-10
1,2-Dichloroethane	8.51E-08	20	AWQC	1	20	4.25E-09
4,4'-DDD	1.61E-07	0.000001	AWQC	1	0.000001	1.61E-01
4,4'-DDE	1.35E-08	0.000001	AWQC	1	0.000001	1.35E-02
4,4'-DDT	3.02E-08	0.000001	AWQC	1	0.000001	3.02E-02
4-Methyl-2-Pentanone(MIBK)	2.06E-42	0.15	AWQC	1	0.15	1.37E-41
Aldrin	4.43E-08	0.0000019	AWQC	1	0.0000019	2.33E-02
alpha-BHC	1.06E-09	0.032	EC-guppy	10000	0.0000032	3.32E-04
Arsenic	2.60E-05	0.19	AWQC	1	0.19	1.37E-04
Benzene	4.58E-14	5.3	AWQC	10	0.53	8.65E-14
beta-BHC	4.69E-09	0.032	EC-guppy	10000	0.0000032	1.47E-03
bis(2-Ethylhexyl)phthalate	2.09E-07	540	LC50-trout	10000	0.054	3.87E-06
Bromochloromethane	4.20E-03	a	a	a	a	a
Cadmium	1.66E-05	0.0011	AWQC	1	0.0011	1.51E-02
Chloroform	2.00E-06	1.24	AWQC	1	1.24	1.61E-06
Chloromethane	6.24E-16	27	LC50-silverside	10000	0.0027	2.31E-13
cis-1,2-Dichloroethene	5.13E-03	11.6	AWQC	1	11.6	4.42E-04
Dieldrin	3.91E-08	0.0000019	AWQC	1	0.0000019	2.06E-02
Endosulfan sulfate	2.76E-09	0.0000056	AWQC	1	0.0000056	4.93E-04
Endrin aldehyde	9.03E-08	0.0000023	AWQC	1	0.0000023	3.93E-02
Ethylbenzene	6.46E-10	42.3	LC100-minnow	10000	0.00423	1.53E-07
gamma-BHC	1.54E-09	0.023	LC50-salmon	10000	0.0000023	6.72E-04
Heptachlor	4.04E-103	0.0000038	AWQC	1	0.0000038	1.06E-97
Heptachlor epoxide	1.73E-08	0.0000038	AWQC	1	0.0000038	4.54E-03
Lead	1.87E-05	0.0032	AWQC	1	0.0032	5.85E-03
Phenanthrene	7.01E-08	0.0063	AWQC	1	0.0063	1.11E-05
Tetrachloroethene	1.25E-07	23.5	LC50-minnow	10000	0.00235	5.31E-05
trans-1,2-Dichloroethene	3.65E-04	11.6	AWQC	1	11.6	3.14E-05
Trichloroethene	7.26E-03	21.9	AWQC	1	21.9	3.31E-04
Trichlorofluoromethane	4.16E-08	a	a	a	a	a
Vinyl Chloride	9.91E-07	388	EC50-pike	100	3.88	2.55E-07

a = no toxicity information available

EQ pike =concentration in water/toxicity benchmark
Concentration in water = modeled groundwater concentrations at a 5-feet range from shoreline (see Appendix C

Table K-37
Building 1845
Ecological Quotients for Aquatic Invertebrates at the Mudflats

Chemical	Conc in GW mg/L	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	Total EQ
1,1,2-Trichloroethane	0.000316405	9.4	AWQC	1	9.4	3.37E-05
1,1-Dichloroethane	3.32386E-05	202	LC50-guppy	10000	0.0202	1.65E-03
1,1-Dichloroethene	8.9515E-07	11.6	AWQC	1	11.6	7.72E-08
1,2-Dichloroethane	5.52416E-05	20	AWQC	1	20	2.76E-06
4,4'-DDD	0.000104787	0.000001	AWQC	1	0.000001	1.05E+02
4,4'-DDE	8.75148E-06	0.000001	AWQC	1	0.000001	8.75E+00
4,4'-DDT	1.95757E-05	0.000001	AWQC	1	0.000001	1.96E+01
4-Methyl-2-Pentanone(MIBK)	1.33605E-39	505	LC50-fish	10000	0.0505	2.65E-38
Aldrin	2.87285E-05	1.9E-06	AWQC	1	0.0000019	1.51E+01
alpha-BHC	6.89414E-07	0.1	EC50-daphnia	100	0.001	6.89E-04
Arsenic	0.016892924	0.036	AWQC	1	0.036	4.69E-01
Benzene	2.97497E-11	5.3	AWQC	1	5.3	5.61E-12
beta-BHC	3.04528E-06	0.1	EC50-daphnia	100	0.001	3.05E-03
bis(2-Ethylhexyl)phthalate	0.000135607	540	LC50-trout	1000	0.54	2.51E-04
Bromochloromethane	2.72590371	a	a	a	a	a
Cadmium	0.010750043	6.4	LC50-plankton	100	0.064	1.68E-01
Chloroform	0.00129643	1.24	AWQC	1	1.24	1.05E-03
Chloromethane	4.05182E-13	27	LC50-bluegill	10000	0.0027	1.50E-10
cis-1,2-Dichloroethene	3.3273942	11.6	AWQC-acute	10	1.16	2.87E+00
Dieldrin	2.53921E-05	1.9E-06	AWQC	1	0.0000019	1.34E+01
Endosulfan sulfate	1.79167E-06	5.6E-06	AWQC	1	0.0000056	3.20E-01
Endrin aldehyde	5.86133E-05	2.3E-06	AWQC	1	0.0000023	2.55E+01
Ethylbenzene	4.19186E-07	275	LC50-shrimp	10000	0.0275	1.52E-05
gamma-BHC	1.00279E-06	0.46	LC48-daphnia	100	0.0046	2.18E-04
Heptachlor	2.6231E-100	3.8E-06	AWQC	1	0.0000038	6.90E-95
Heptachlor epoxide	1.12077E-05	3.8E-06	AWQC	1	0.0000038	2.95E+00
Lead	0.012157787	0.0032	AWQC	1	0.0032	3.80E+00
Phenanthrene	4.55093E-05	0.063	AWQC	1	0.063	7.22E-04
Tetrachloroethene	8.10417E-05	18	LC48-daphnia	100	0.18	4.50E-04
trans-1,2-Dichloroethene	0.236756895	11.6	AWQC-acute	10	1.16	2.04E-01
Trichloroethene	4.711153945	21.9	AWQC	1	21.9	2.15E-01
Trichlorofluoromethane	2.70139E-05	a	a	a	a	a
Vinyl Chloride	0.00064345	388	EC50-pike	10000	0.0388	1.66E-02

a = no toxicity data available
EQ=Concentration in water/toxicity benchmark
Concentration in water = modeled groundwater concentrations discharging to the shoreline (see Appendix C)

Table K-38
Building 1845
Ecological Quotients for the Spotted Sandpiper at the Mudflats

Chemical	Conc in GW mg/L	Insect Uptake Factor	Conc in Invert mg/kg	SSP Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Water	% EQ Invert.	Total EQ
1,1,2-Trichloroethane	0.000316	17	0.005379	2.10E-04	195	LOAEL-mouse	100	1.95	86.60	13.40	1.08E-04
1,1-Dichloroethane	3.32E-05	6.6	0.000219	2.03E-05	725	LD50-rat	10000	0.0725	94.33	5.67	2.79E-04
1,1-Dichloroethene	8.95E-07	2.5	2.24E-06	5.26E-07	3331	LOAEL-mouse	100	33.31	97.77	2.23	1.58E-08
1,2-Dichloroethane	5.52E-05	2	0.00011	3.23E-05	46.81	NOAEL-robin	1	46.81	98.21	1.79	6.91E-07
4,4'-DDD	0.000105	12000	1.257449	6.64E-03	0.00032	NOAEL-heron	10	0.000032	0.91	99.09	2.08E+02
4,4'-DDE	8.75E-06	12000	0.105018	5.55E-04	0.00032	NOAEL-heron	10	0.000032	0.91	99.09	1.73E+01
4,4'-DDT	1.96E-05	12000	0.234908	1.24E-03	0.00032	NOAEL-heron	10	0.000032	0.91	99.09	3.88E+01
4-Methyl-2-Pentanone(MIBK)	1.34E-39	2.1	2.81E-39	7.83E-40	100	LD50-blackbird	10000	0.01	98.12	1.88	7.83E-38
Aldrin	2.87E-05	3140	0.090207	4.89E-04	0.045	NOAEL-heron	10	0.0045	3.38	96.62	1.09E-01
alpha-BHC	6.89E-07	1100	0.000758	4.37E-06	0.226	NOAEL-heron	10	0.0226	9.08	90.92	1.93E-04
Arsenic	0.016893	9	0.152036	1.05E-02	0.111	NOAEL-vole	10	0.0111	92.43	7.57	9.46E-01
Benzene	2.97E-11	4.27	1.27E-10	1.78E-11	23.23	NOAEL-vole	10	2.323	96.26	3.74	7.65E-12
beta-BHC	3.05E-06	1460	0.004446	2.50E-05	0.226	NOAEL-heron	10	0.0226	7.00	93.00	1.11E-03
bis(2-Ethylhexyl)phthalate	0.000136	1000	0.135607	7.88E-04	1.39	NOAEL-robin	10	0.139	9.90	90.10	5.67E-03
Bromochloromethane	2.725904	a	a	a	a	a	a	a	a	a	a
Cadmium	0.01075	2213	23.78984	1.31E-01	60	dose-chicken	10000	0.006	4.73	95.27	2.18E+01
Chloroform	0.001296	8	0.010371	7.99E-04	29.7	NOAEL-vole	10	2.97	93.21	6.79	2.69E-04
Chloromethane	4.05E-13	2.88	1.17E-12	2.39E-13	500	LOAEL-mouse	100	5	97.44	2.56	4.78E-14
cis-1,2-Dichloroethene	3.327394	23	76.53007	2.31E+00	39.8	NOAEL-vole	10	3.98	82.68	17.32	5.81E-01
Dieldrin	2.54E-05	2700	0.068559	3.73E-04	0.045	NOAEL-heron	10	0.0045	3.91	96.09	8.30E-02
Endosulfan sulfate	1.79E-06	59	0.000106	1.58E-06	17.22	NOAEL-robin	100	0.1722	65.05	34.95	9.19E-06
Endrin aldehyde	5.86E-05	121	0.007092	7.08E-05	0.73	NOAEL-robin	100	0.0073	47.58	52.42	9.70E-03
Ethylbenzene	4.19E-07	144	6.04E-05	5.57E-07	3500	LD50-rat	10000	0.35	43.27	56.73	1.59E-06
gamma-BHC	1E-06	319	0.00032	2.25E-06	4.66	NOAEL-robin	10	0.466	25.61	74.39	4.83E-06
Heptachlor	2.6E-100	20	5.2E-99	1.78E-100	92	LC50-quail	10000	0.0092	84.59	15.41	1.94E-98
Heptachlor epoxide	1.12E-05	20	0.000224	7.62E-06	92	LC50-quail	10000	0.0092	84.59	15.41	8.28E-04
Lead	0.012158	42	0.510627	9.66E-03	100	dose-gull	10000	0.01	72.34	27.66	9.66E-01
Phenanthrene	4.55E-05	325	0.014791	1.04E-04	700	LD50-mouse	10000	0.07	25.26	74.74	1.48E-03
Tetrachloroethene	8.1E-05	49	0.003971	6.74E-05	1.23	NOAEL-vole	10	0.123	69.15	30.85	5.48E-04
trans-1,2-Dichloroethene	0.236757	23	5.445409	1.65E-01	39.8	NOAEL-vole	10	3.98	82.68	17.32	4.14E-02
Trichloroethene	4.711154	17	80.08962	3.13E+00	1000	LOAEL-mouse	100	10	86.60	13.40	3.13E-01
Trichlorofluoromethane	2.7E-05	a	a	a	a	a	a	a	a	a	a
Vinyl Chloride	0.000643	5.1	0.003282	3.87E-04	5.60	LOAEL-rat	1.00E+02	0.056	95.56	4.44	6.91E-03

Table K-38
Building 1845
Ecological Quotients for the Spotted Sandpiper at the Mudflats

Chemical	Conc in GW mg/L	Insect Uptake Factor	Conc in Invert mg/kg	SSP Intake mg/kg-d	Toxicity Data mg/kg	Reference	Uncert Factor	Toxicity Benchmark	% EQ Water	% EQ Invert.	Total EQ

Spotted Sandpiper Constants:		
Body weight (BW):	kg	0.047
Water Intake (WI):	L/day	0.67
Food Ingestion rate (FI):	kg/day	0.00744
Soil Ingestion fraction (S):	unitless	0.18
Food Ingestion fraction (F):	unitless	0.82
Home Range:	acres	2.5
Time on site:	months	5
Home Range Fraction (HR):	unitless	0.096
Site Area:	acres	0.24

a = no toxicity data available
EQ = sandpiper intake/toxicity benchmark
Intake = (HR/BW) x 0.42 x ((Conc in Invert x FI x FF) + (Conc in water x WI))
Conc. in Water = modeled groundwater concentrations discharged to the mudflats (Appendix C)